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THE BEET SUGAR INDUSTRY.

I.—INTRODUCTION.

Hon. Allan McLean, M.P.

In my opinion, the failure of our first attempt to establish the beet sugar industry at Maffra was due principally to two causes. First, an

THINNING BEET AT MAFFRA.

insufficient supply of the raw material to work up; and, second, the inability of our experts to extract the usual percentage of the sugar contained in the roots, as proved by analysis.

Taking the last of these causes first, I may mention that the 9,000 tons of beet roots supplied to the factory during the first season were

shown by analysis to contain upwards of 14 per cent. sugar contents. From such roots we should have got at least from 9 to 10 per cent. of white granulated sugar. Speaking from memory, however, I think we only got about 5½ per cent.; and, as the cost of extraction would be the same in each case, this enormous shortage would in itself make all the difference between success and failure.

The German experts attributed their inability to extract the proper percentage of sugar to the presence of an unusual proportion of invert sugar in the roots—that is, sugar that will not crystallize. They considered this was due to the beets having been grown on virgin soil, and said it would disappear when the land was cultivated for a year or two.

In my opinion, it was due chiefly to defective cultivation, such as the absence of autumn ploughing, winter fallowing, artificial fertilizers, and general laxity in working the soil, also to the fact that a large proportion of the roots were left on the field for two weeks, or more, after being topped, before delivery at the factory. When the top is cut off, the root begins to bleed, and, if left too long, this is liable to produce fermentation, which retards crystallization. It should not be difficult to test this matter by cultivating a few plots properly, and treating the roots within a reasonable time of being topped.

In order to secure a sufficient supply of beets to justify the reopening of the factory, it would, I believe, be necessary to get 500 or 600 growers, as each should only be asked to cultivate a few acres, which he could attend to properly by utilizing the labour of his own family. These plots should be grown in rotation with other crops, and would prove a valuable adjunct to dairying, as the by-products are an excellent milk-producing food for cows. The land should be ploughed about the end of autumn, allowed to lie in fallow during the winter, ploughed and worked into a fine tilth in the early spring. Before sowing the seed, proper fertilizers should be used, and weeding, thinning, and scarifying attended to.

I would suggest that during the first five years the Government should make such railway concessions as would enable farmers to grow all along the line from Bairnsdale to Warragul, also on the line *viâ* Sale, and to Briagolong.

If it can be proved that the industry will pay, and that beets can be profitably produced, in rotation with other crops, and as a valuable adjunct to dairying, fattening stock, &c., I have no doubt but a sufficient supply can be obtained, in a few years, within easy distance of the factory. I need hardly say that, if the Maffra factory succeeds, it will not be long before private enterprise will establish similar factories in other parts of the State.

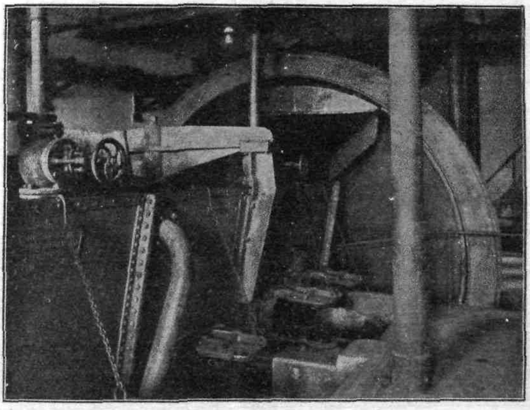
II.—SOME OF THE PROBLEMS ASSOCIATED WITH THE REVIVAL OF THE INDUSTRY.

F. E. Lee, Agricultural Superintendent.

As public attention has recently been drawn to the prospects of reviving the beet sugar industry at Maffra, some details in connexion with the agricultural and associated problems involved will be of general interest. Until comparatively recently there has prevailed such misconception of the history of the Maffra venture that the mere mention of the word "beet" was sufficient to excite the scorn and ridicule of the casual observer.

After an interval of seven years, many of the objections raised and prejudices held by land-holders in North Gippsland have passed away, and it is now satisfactory to find that a genuine interest is being manifested in the discussion of the liberal proposals for reopening the factory. The recent visit of the Minister for Agriculture (Hon. George Swinburne, M.L.A.) to Maffra elicited from the large attendance of farmers who met him on that occasion the pleasing statement that they had sufficient faith in the resources of their district to again make an attempt to establish the industry.

The nebulous theories and practical suggestions offered from time to time since the factory closed down have now been crystallized by the Minister into concrete proposals. These proposals are being explained



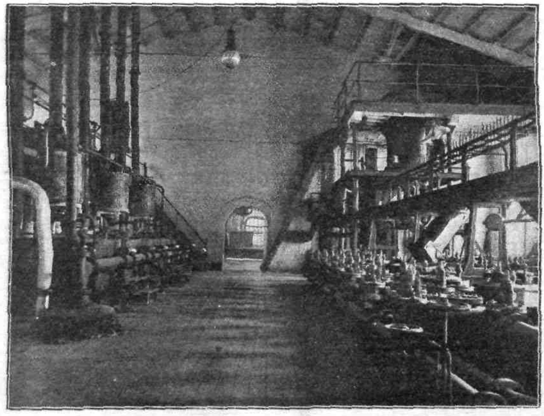
BEET ELEVATING WHEEL AND WASHING TROUGH.

to meetings of farmers and others interested by the writer of this article, and the prospects of a sufficient area of land being guaranteed to start the factory are, at the time of writing, by no means bad.

SOME DETAILS OF THE BUILDING AND PLANT AT MAFFRA.

For the benefit of those readers who may be unacquainted with the capacity and equipment of the Maffra Beet Sugar Factory, a few details of the building and plant are given. The factory premises, situated in a compact block of 30 acres, are within 200 yards of the Maffra railway station, and are connected therewith by two lines, with switches, one for unloading beets at the receiving bins, and the other for the despatch of manufactured sugar. A railway weighbridge facilitates the weighing of beets arriving by rail. The factory building is of bold design, and was

built with sufficient room for future expansion. The complete plant—comprising washing, elevating, slicing, diffusion, purification, evaporation, sulphitation, boiling, and centrifugal machines—was supplied by the Brunswick Machinery Company (Germany), at a cost of £33,149. The capacity of the plant is guaranteed to 350 tons per day, but the plant can, on emergency, treat over 400 tons of beet in 24 hours. So far as may be gathered from the reports of professional engineers, the plant is in every way capable of performing the work put upon it, and little of the past failure can be ascribed to the working of the plant or the quality of the sugar produced. It might be mentioned that the selling price of the Maffra beet sugar on the Melbourne market was £22 per ton, a sufficient guarantee that the quality was all that could be desired.



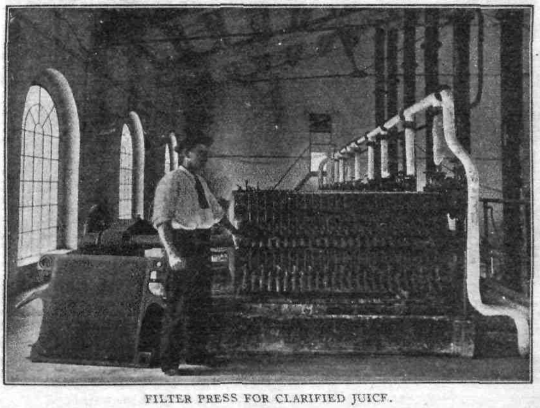
VIEW SHOWING DIFFUSION BATTERY ON RIGHT, JUICE CLARIFICATION TANKS ON LEFT.

The water supply necessary for the working of the factory was drawn from the McAlister River hard by. Firewood and limestone were procured locally, the latter coming by rail from Dutson. Adequate provision is made for the disposal of the "pulp," as the by-product is called after the sugar is extracted, and railway trucks or drays may be filled with little or no delay.

THE CAMPAIGNS OF 1898 AND 1899.

The factory began operations in April, 1898, and it was not long before it was found that the vehicles possessed by the local growers were inadequate to furnish the daily tonnage of beet demanded. The delays caused to the factory management, and the mounting up of expenses, may be passed over with the remark that these matters were unavoidable at the

time, because unforeseen; but they were sufficient to impress the directorate that the transport of the roots was a matter that urgently demanded attention in the future. The amount of clean beets delivered during the first campaign was 8,758 tons, and for the second campaign 6,317 tons. These quantities by no means represent the total amount of beet grown in the Maffra district. A considerable proportion of the total area grown —equal, approximately, to 20 per cent.—was never harvested, or, if harvested, the beets were not delivered at the factory, on account of the low price ruling at the latter end of the harvesting campaigns. Payment for beets was made on a sliding scale, according to the percentage of sugar present. In addition to the other pioneer difficulties encountered by the beet growers, a heavy fall of rain occurred in the autumn, and caused a serious deterioration of the sugar content of the beets, by producing an abundant growth of new leaves. Later experience has shown that it is



FILTER PRESS FOR CLARIFIED JUICE.

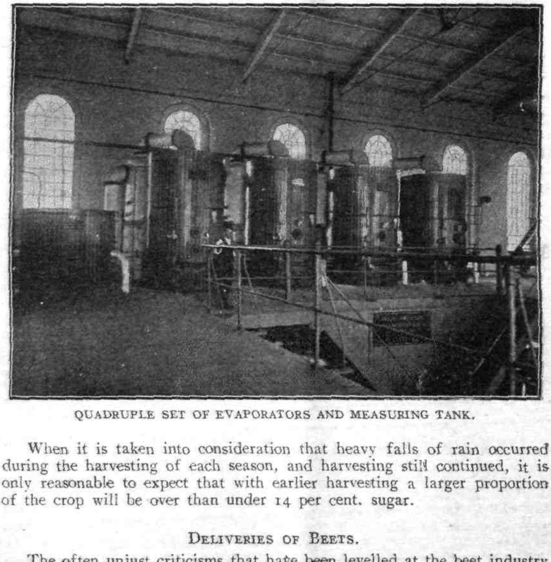
a mistake to continue the harvest immediately after a heavy fall of rain, because, given a week or two, the beets will nearly, if not wholly, regain their sugar content, while the weight of the crop is materially improved. It is only right to point out that early autumn rains may always occur in the Maffra district, but the weather records for the past 25 years show that these early rains are invariably followed by periods of dry weather. With an early harvest, a great proportion of the beet crop would not be subjected to deterioration by rains, while the remainder, if the sugar content is reduced, may be safely left to recover itself, with advantage both to the grower and the manufacturer.

QUALITY OF THE BEETS.

To account for past failures, the statement has been made that the Maffra district was incapable of producing beets of a sufficiently high

sugar content to permit of their being profitably manufactured into sugar A glance at the figures below, which are taken from the factory books, and are the qualities on which beet suppliers were actually paid, do not substantiate this opinion:—

Tons of Beets delivered between 12 and 14 per cent. sugar.		Tons of Beets delivered between 14 and 16 per cent. sugar.		Tons of Beets delivered between 16 and 18 per cent. sugar.	
1898.	1899.	1898.	1899.	1898.	1899.
5,443	4,029	2,907	1,719	408	569



QUADRUPLE SET OF EVAPORATORS AND MEASURING TANK.

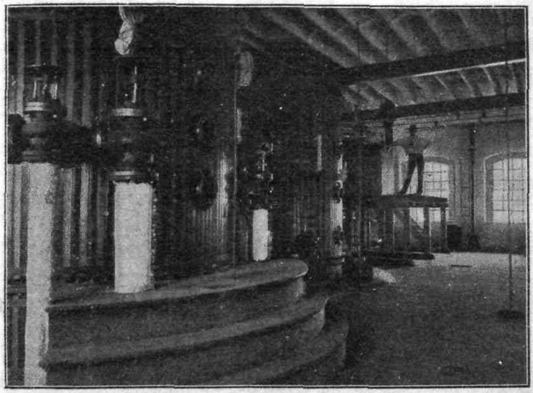
When it is taken into consideration that heavy falls of rain occurred during the harvesting of each season, and harvesting still continued, it is only reasonable to expect that with earlier harvesting a larger proportion of the crop will be over than under 14 per cent. sugar.

DELIVERIES OF BEETS.

The often unjust criticisms that have been levelled at the beet industry have invariably ascribed portion, if not all, of the failure in the past to mismanagement in the factory. That this was hardly the case is clearly shown by a scrutiny of the average daily deliveries of beets at the factory during the first and second seasons.

It will be remembered that the capacity of the factory is 350 tons per day of 24 hours. Beet deliveries take place only in the day time, so

that the daily deliveries should cover both day and night work. The factory management was severely hampered from the very outset by the fact that the number of farmers growing beet was only small. In addition, the Beet Company itself grew 300 acres in 1898, and 559 acres in 1899; the Cultivation Company (a local syndicate of business people) provided 270 acres, and a syndicate formed among the directors of the Company grew 100 acres. Three-fifths of the total supply came from the three large syndicates. Absence of suitable labour—or, in fact, labour of any kind whatever—was wholly responsible for the smallness of the amount delivered per day. The farmers for the most part depended on their own labour and vehicles, and



VACUUM PANS FOR BOILING SUGAR.

as a consequence were not able to supply more than a fraction of the daily amount.

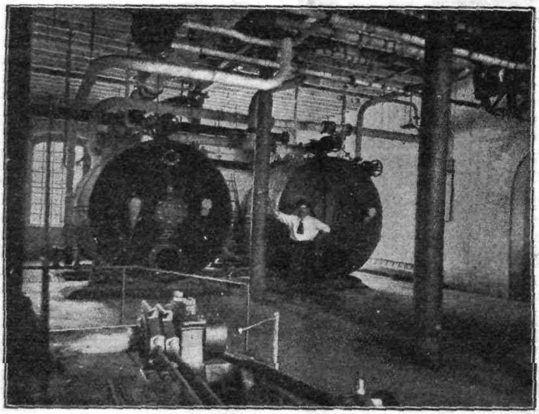
Daily tonnage of beets delivered.		Maximum amount delivered in one day.		Minimum amount delivered in one day.	
1898.	1899.	1898.	1899.	1898.	1899.
162	130	261	208	30	1[illegible]

These figures are eloquent enough in themselves, and show convincingly that one of the primary reasons of failure was that the daily delivery of beet was never more than sufficient to give a half supply. Workmen cannot be put off from one hour to another, nor can steam be allowed to go down in a large concern like the Maffra factory, so that it is not surprising the

cost of manufacturing the beets into sugar was abnormally high. All the causes mentioned are remediable, and, in point of fact, it is only on the understanding that such leakages could be stopped that any attempt could be made to reopen the factory profitably.

SOME CONTRIBUTING CAUSES OF FAILURE.

So far as the previous history of beet-growing is concerned, the principal causes of failure must be looked for outside the factory. From a beet-grower's point of view, the sole concern he has is whether it will pay him to grow beet or not. The experience of the past has not been of the most profitable order, but there is much to be said for the often abused beet-grower.

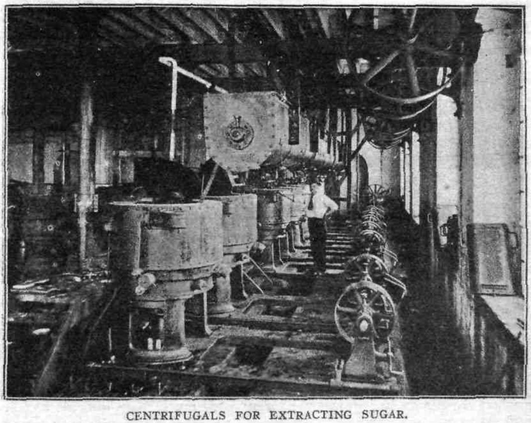


SUGAR GRANULATORS AND DRIERS.

In the first place, individual growers were asked to undertake too large areas. The small number of suppliers made it impossible, as already shown, to maintain even a half supply of beets. The preparation of the land was, without exaggerating, in the majority of cases abominable. Grass land ploughed in the spring, in North Gippsland, is unfit for most crops, and particularly so for beets. At that period there is usually windy weather, and the land is denuded of moisture before the seed is sown. Some of the growers were altogether unprovided with the ordinary farm equipment of implements, and 40 per cent. of them had no vehicle for transporting beet, other than a single-horse dray or the light spring cart ordinarily used for conveying milk to the butter factory. Late sowing, absence of prompt thinning, and in many cases total neglect of after cultivation, were contributory causes to the ill-success of the first

season's crop. On the top of these drawbacks came a wet harvest, rendering carting not only difficult but in some cases impossible, on account of flooded roads. The uncertainty of securing further assistance from the Government in the second season again prevented an early winter cultivation of the land.

There was a distinct advance shown in the methods and promptness of the thinning during the second season, but an unprecedented spell of dry, windy weather throughout the spring and summer gave little hope of the crops making much weight per acre. The harvest of the second crop was begun a month earlier than in the previous year, and resulted, as may be seen, in a better proportion of beets over 14 per cent. sugar. I am satisfied that when the beet crop is normally grown, as would be the case



CENTRIFUGALS FOR EXTRACTING SUGAR.

with a winter preparation of the land, the dangers to be feared from second growth taking place at harvest time are considerably lessened. By adopting the remedy of an early harvest the management of the beet factory would have the bulk of the beets out of the ground before the end of April.

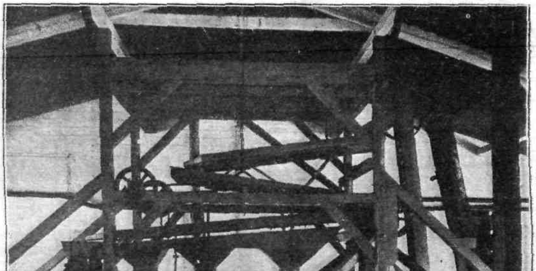
IS BEET-GROWING PROFITABLE?

Under the conditions prevailing in the past, the answer to the above question can only be in the negative. It will be admitted by all who have had previous experience that the beet crop had little chance of success, considering the paucity of attention given to it. Other crops, such as cereals and maize, failed the same years as the beet, on account of dry weather.

What improvements, then, can be looked for to insure a greater measure of success in the future? First and foremost, the preparation of the land at the proper moment, viz., the months of April, May, or June at the

latest; a thorough surface cultivation in the middle of August, to get rid of millions of germinating weed seeds; earlier sowing than has hitherto prevailed.

I am prepared to say that beet can be planted in the early part of August, with no danger whatever from frost. By planting portion of the area at a time with, say, a week or ten days' interval, the thinning is easily handled, and the beet crop does not call for the whole attention of the grower, to the exclusion of his other farm or dairy work. In this one matter lay a great deal of the non-success and delay of thinning in the past. A grower of 10 acres, by planting it all at once, had that amount on hand to thin without delay. By the time the last 3 or 4 acres were



SUGAR SIEVES AND BAGGING APPARATUS.

reached the plants had grown too large, were much more difficult to thin, and the plants left suffered more from shock than if thinned at the proper moment. Considerable improvement might also be effected in the class of drills used. Since the Maffra factory closed down American beet-growers have succeeded in obtaining a machine which will plant the seed in "pockets" at 6 or 8 inch spaces. This economizes seed, renders the thinning less tedious, and gives a more regular stand of beets. I have heard of a machine which, by cross-hoeing the rows at right angles, will effect the purpose of leaving the plants in small clumps, but I am inclined to believe that this machine would only do perfect work when the land was quite level, and the germination of the seed regular. Of the two methods of reducing the labour of thinning, I favour the use of the "pocket" drill, but at the same time appreciate the possibilities of the cross-hoeing system.

Prompt thinning is imperative if a healthy stand of beets is to be procured, and no other work should be given precedence of this by the careful beet-grower. After cultivation embraces all the operations of inter-tillage.

No one particular implement is better than another. Any of the single or multi-toothed implements now in use will be found suitable, provided they do not injure the plants in any way. Hoeing, either by hand or horse implement, plays a double part in the well-being of a crop. It keeps down weed growths, and, above all, it checks evaporation by the preservation of a loose mulch of surface soil. It is impossible to say how many hoeings may be necessary, but a safe plan is to horse-hoe the beet crop every ten or twelve days, until such time as the spread of the leaves makes further working impossible. It is a well-accepted axiom among Continental beet-growers that "the sugar is hoed into the beet," and no pains are spared to accomplish that object.

In order to ascertain if beet-growing is profitable or not, I have procured the following estimate of the expenses of growing an acre of beet from a prominent beet-grower in the Maffra district:

	£	s.	d.
Rent of land	£1	0	0
Winter ploughing	0	15	0
Harrowing three times, at 1s.	0	3	0
Rolling once	0	1	0
Cost of seed, 12 lbs., at 8d.	0	8	0
Cost of sowing	0	1	6
Thinning	1	5	0
Hoeing twice, at 6s.	0	12	0
Ploughing out	0	5	0
Topping 12 tons, at 2s. 6d.	1	10	0
Carting three miles by waggon	1	10	0
	£7	10	6

This estimate allows a fair rate of wages being paid to the grower, and allows him also to charge for the use of his own horses and implements. As a set-off against the above cost, the grower may expect the following moderate yield:—

	£	s.	d.
12 tons beet, at 16s. per ton	£9	12	0
6 ,, pulp, at 1s. ,, ,, ...	0	6	0
2 ,, leaves, at 1s. ,, ,, ...	0	2	0
	£10	0	0

This would leave a liberal margin of £2 10s. per acre net profit. The yield per acre reckoned upon is only moderate, and one which will be exceeded by those growers who give special attention to the beet crop.

Even if the profit per acre were reduced from £2 10s. to £1 10s. per acre, it would still show as good a return as hay growing, and I further believe that if the dairymen charged the same expenses of rent, labour, plant, &c., beet growing would still hold its own as a source of income. Nearly the whole of the above expenses could be earned by the farmer and his family.

COMPARISON OF VICTORIAN AND AMERICAN ESTIMATES FOR GROWING AN ACRE OF SUGAR BEET.

In order to ascertain the relative costs charged for the same operations by the Victorian beet grower and his American cousin, I extract the

following estimate from *The American Sugar Industry*, by Herbert Myricl 1902, the most recent publication on the beet industry :—

	Victorian.		American.
Rent of land	£1 0 0	...	£0 16 0
Cost of preparation, including seed and cost of sowing	1 8 6	...	1 14 0
Cost of thinning	1 5 0	...	1 0 0
Keeping crop clean during growth	0 12 0	...	2 7 6
Cost of harvesting, including ploughing out and topping	1 15 0	...	1 8 0
Carting 12 tons 3 miles ...	1 10 0	...	1 13 2
	£7 10 6	...	£8 18 8

There does not appear, after all, to be a very great deal of difference between the two totals, but when the details are analyzed separately, the points of difference are remarkable :—

Rent of Land.—In this respect the American grower has a slight advantage.

Preparation of the Land.—In this matter the American spends 5s. 6d. per acre more than the Victorian. The cost of the operations is much the same, therefore the difference can only be in the number and variety of the operations.

Cost of Thinning.—In this item, despite the frequently-expressed contrary opinion, the Victorian grower has little to learn from the American, save, perhaps, the promptness with which the work is performed.

After Cultivation.—The after-cultivation is the operation in beet growing that has more influence than any other on the ultimate yield of the crop. Note the difference in the amounts spent by the beet growers of Victoria and America. The former spends a beggarly 12s. per acre in two horse hoeings; the latter a sum of £2 7s. 6d., covering two hoeings by hand, one preceding and one following the thinning, besides six horse hoeings.

I am convinced that herein lies a great deal of the non-success in beet growing as carried out by the Victorian farmer. While the beet crop is young it wants constant attention. The young plant grows very rapidly in its early stages, and makes heavy demands on the moisture supply of the soil. If this moisture is not conserved by hoeing to arrest evaporation, the young plant soon receives a check in growth, and the hot weather of the summer months of December, January, and February effectually prevents the plant making its maximum growth.

I need not draw especial attention to the presence of weeds in Gippsland soils; they are prevalent enough everywhere, but I may be allowed to remark that there are few cultivated plants that respond better to cultivation than do beets, and unless a radical improvement is introduced into future beet growing ventures, there are bound to be similar stories told of ill-success.

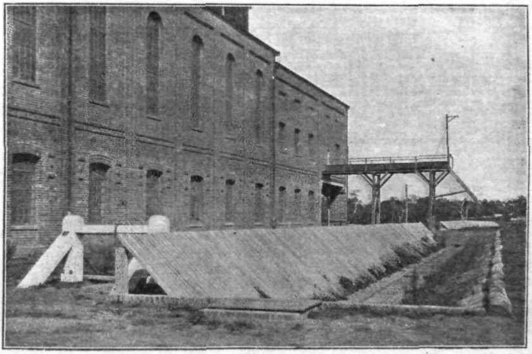
Carting.—The distance from the field to factory or nearest railway station must always regulate the cost of this item for beet as for all other

farm produce. I have consistently urged the importance of this matter from the factory point of view, and the details already given of the daily deliveries of beet are sufficient to justify the organization of a transport system by the management.

A factory without an adequate supply of raw material is helpless, and if beets are to be drawn from a wide radius by rail and road, it is imperative that proper arrangements be made to insure an improvement in this direction. There would be little difficulty in organizing the routes for a number of traction engines and waggons to take delivery of beets along the roadside; if adopted, this arrangement would relieve the grower of a great responsibility, and would permit of continuous work for the factory plant.

THE GOVERNMENT PROPOSALS.

The present situation of the beet industry stands as follows:—The Government possess the factory building, plant, and premises. The machinery has not deteriorated since the late Company ceased operations, having been well cared for in the meantime. While the plant is inoperative,



VIEW SHOWING BEET BIN IN FOREGROUND AND PULP DISCHARGE IN REAR.

the large sum of £62,000 invested in the industry by the Government is lying idle, with no prospect whatever of the money coming back to the Crown. As a result of personal inquiry into the reasons of failure, the Minister for Agriculture has been authorized by the Cabinet to make the following proposals to farmers and land-holders interested in the establishment of the beet sugar industry on a sound basis:—

(*a*) Farmers to undertake to grow beet for a term of five years.

(*b*) Areas of from 2 to 10 acres to be prepared, planted, and grown under the supervision of officers of the Department of Agriculture.

(*c*) The Department to supply seed at cost price.

(*d*) For the first season all topped, clean beet shall be paid for at a uniform price of 16s. per ton, delivered at the factory, if the

sugar content amounts to 12 per cent. or upwards. A reduction in price of 1s. per ton shall be made for each 1 per cent. reduction in the sugar percentage below 12.

(*e*) In order to encourage growers at a distance from Maffra, the Department will make a rebate on the railway freight when this amounts to more than 2s. per ton. The maximum rebate will be 2s. per ton. Thus, if the freight is 3s. per ton, the Department will pay 1s. and the grower 2s. If it amounts to 4s. or over, the Department will pay the maximum of 2s.

(*f*) Until proper pulp-drying machinery has been erected at the factory, all suppliers will be entitled to the pulp produced from their beets free of cost, delivery to be taken at the factory. On erection of such machinery, suppliers will be charged with the net cost of drying.

(*g*) After paying 10 per cent. on capital to cover interest and depreciation of plant, all profits will be divided *pro rata* as a bonus among the growers. The cost of reopening the factory will be added to the capital account.

(*h*) The Department will not go on with the scheme unless 3,000 acres are guaranteed.

(*i*) The bonus will not be paid to any grower until the following season's crop has been planted and thinned.

(*j*) After the first season, payment for beet and division of the bonus will be arranged solely on the basis of the percentage of available sugar in the beets.

EXPLANATION OF THE PROPOSALS.

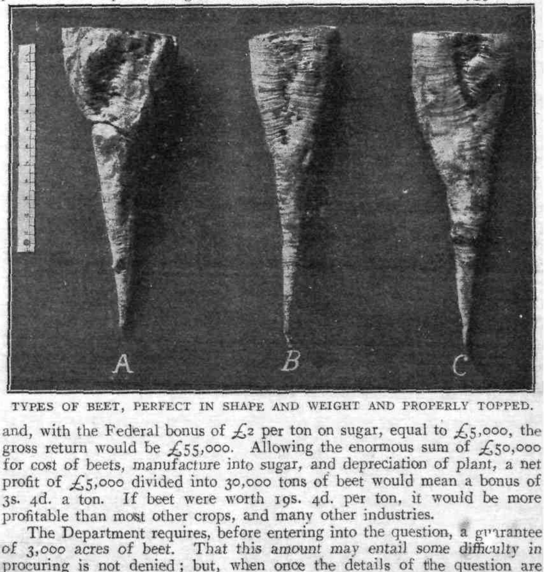
The writer of this article has been instructed by the Minister to personally canvass the districts between Warragul and Bairnsdale, and explain to meetings of farmers and others interested the details of the above proposals. It may be here said that a guarantee to grow beets for five years may reasonably be expected if the Government is to undertake the responsibility and expense of reopening the factory. The areas asked for are small, and intending beet-growers are unlikely to undertake more than they are capable of carrying out. It is recognised that to make the industry a success, there must be a large number of small growers. The more persons engaged in beet-growing, the less chance there is of a break-down in the supply, and the more likelihood of the area being extended, should the venture prove a success.

The price offered, viz., 16s. per ton for 12 per cent. beet, is a most liberal one, and marks an advance of 33⅓ per cent. on previous rates paid for beets of a similar quality. Beets grown under capable supervision are unlikely to be below this content, and, should heavy falls of rain deteriorate the sugar content of the roots, the management can arrange for roots being left in the ground until they recover.

The rebate on railway freights will permit of beet being grown at considerable distances from Maffra, and will thus bring in persons in other localities that were previously prohibited from profitably growing beet on account of the high freight charges. Where pulp is required to be returned to growers by rail, the same rebate will be allowed in freight as on beets. The ultimate drying of the pulp will materially reduce the railway freight. It will be noted that only beet-growers will receive pulp free of charge.

The deduction of 10 per cent. to cover interest, depreciation of plant, &c., will be made on the original amount invested by the Government, plus the cost of re-opening the factory; but, as a set-off against this, the Government will be entitled to claim a bonus of £2 a ton on white-grown sugar, under the Commonwealth Sugar Act. This bonus for white-grown sugar will nearly, if not entirely, cover the deduction for interest, depreciation, &c.

The division of the net profits as a bonus to beet-growers should stimulate those interested, because it will mean an additional price for the beet. Calculating on an acreage of 3,000 acres, with an average yield of 10 tons per acre, the factory would work up 30,000 tons of beet. Assuming that it would require 12 tons of beet to make one ton of granulated sugar, there would be 2,500 tons of sugar. Valuing the sugar at £20 per ton, the present market price, the gross return from the factory would be £50,000;



TYPES OF BEET, PERFECT IN SHAPE AND WEIGHT AND PROPERLY TOPPED.

and, with the Federal bonus of £2 per ton on sugar, equal to £5,000, the gross return would be £55,000. Allowing the enormous sum of £50,000 for cost of beets, manufacture into sugar, and depreciation of plant, a net profit of £5,000 divided into 30,000 tons of beet would mean a bonus of 3s. 4d. a ton. If beet were worth 19s. 4d. per ton, it would be more profitable than most other crops, and many other industries.

The Department requires, before entering into the question, a guarantee of 3,000 acres of beet. That this amount may entail some difficulty in procuring is not denied; but, when once the details of the question are understood, there is sufficient enterprise in Gippsland farmers to guarantee more than this area.

THE PULP QUESTION.

One of the matters of paramount importance to the dairy farmer is the supply of succulent fodder for his stock. The production of this

fodder is, as yet, not as assured, or as regular, as it might be. The refuse pulp from a beet factory has very great advantages for the feeding of dairy cows, as is evident from the following analyses :—

——	Beet Pulp	Clover Silage.	Maize Silage.
Water	90.0	72.0	70.6
Ash	.3	2.6	2.6
Protein...	1.5	4.2	2.7
Fat	.4	1.2	.7
Sugar and Starch ...	4.7	11.6	13.7
Fibre	3.1	8.4	9.7

From these figures it will be seen that fresh beet pulp has nearly one-half the value of maize silage. If the surplus water is dried out, the beet pulp

BEET CROP BEING HARVESTED.

would have about the same value for feeding purposes. One great advantage beet pulp has over ensilage is that it does not require any expensive silo for storage purposes. Beet pulp, if desired to be used to the best advantage, can be stacked and covered with a layer of straw and earth, in a similar way as potatoes are pitted.

CONCLUSION.

In conclusion, a few words might be said of the meteoric rise of the beet industry in the United States, after many years of pioneering non-success. Six years ago there were over 50 factories in operation, with an invested capital of 34,000,000 dollars. The money paid to farmers was 15,200,000 dollars a year, equal to £3,040,000. In Germany, eight years ago, there were over 400 factories in operation, using beets from 1,080,256

acres of land. The average yield per acre in Germany was 12.2 tons, and the average quality of the beet 12.7 per cent.

The area under beets on the Continent up to the year 1896 was 37,000,000 acres, or an area equal to nearly one-half that of the State of Victoria. In the same year the world's production of sugar was: Beet, 4,773,000 tons; cane, 2,432,000 tons.

A thoughtful study of these statistics should be sufficient to impress even the most prejudiced mind that the potentialities of beet-growing in Victoria are almost unlimited. The initial failure in Victoria was discouraging, but there is no logical reason why the Victorian beet sugar industry should not rise, Phœnix-like, from the ashes of its own dead past.

CLOSER SETTLEMENT STUDIES.

DAIRYING AT SWAN HILL.

P. J. Carroll, Dairy Supervisor.

Unlike the farmers in the rich Western District who started on small areas, the farmers of Swan Hill district commenced on large holdings, and have yet to learn much of the secret of getting the maximum return out of a limited area, or, in other words, the adoption of a system of intense culture. It is disagreeable to say it, but one cannot help feeling that until recent years farming in this district was carried on by slipshod methods. Whatever it may have been in the past, however, one cannot help becoming imbued with the change that is now taking place. The progress and enthusiasm shown by many of the settlers bid fair to bring the state of productiveness of this district up to the position which it should have attained years ago, and to which it was originally intended owing to its great fertility.

The land is a dark, grey loam, resting on heavy clay, and forming what are termed the "flats," or "Murray Flats." The chief feature of this land generally is its richness, growing prolifically almost any crop sown on it, provided sufficient moisture is made available. The great difficulty, however, is the low rainfall—about 12 inches per annum—which renders artificial watering necessary. This is now being done on a small scale, and almost every farm has its channels and its checks, and the rainfall is thereby supplemented on at least a portion of the holding.

The land is found to be admirably adapted for irrigation on account of its splendid drainage, and the crops and pastures immediately respond to the treatment. Much has yet to be learnt in this direction, so as not to detrimentally affect the physical and mechanical condition of the soil by the injudicious use of water. There is less fear of such a result in the district under notice, as the land seems to be naturally adapted to irrigation. When discussing the subject of irrigation generally with a resident of the "flats," I ventured to say that irrigation would yet solve the closer settlement question, even in districts situated long distances from the main rivers; but he shook his head, and said that "Nature in her wisdom made land that was destined to be flooded suitable for that condition until the hand of man altered it; and consequently when the same state was brought about by artificial means on land that was not subject to periodical flooding, it was liable to have an injurious effect; but, on the other hand, land where annual floods were the rule would not be injured."

I have not sufficient experience to say that this statement is perfectly true, but it certainly appears to be at least worthy of some consideration.

There is no question but that land in this district periodically under flood is not injured either physically or mechanically by the yearly flooding, and such land must lend itself successfully to artificial watering to supplement the rainfall.

Without unduly criticising the methods of the farmers occupying this land, it may safely be said that the best use has not been made of the opportunities. Of late years, however, cultivation of the cereal crops only has given way to the more regular and reliable operation of dairying. Whilst many of the farmers have not yet grasped the idea that beef cows do not usually make dairy cows, and the importance of culling out the wasters and filling their places with heifers from their best dairy cows (as determined by the keeping of records of milk yield and testing for butter fat), some at least are adopting these methods.

The returns which I am about to give were taken from factory records of the dairymen themselves; in every case precautions were taken to verify same, and from my knowledge of the district and the men from whom the figures were obtained there is no reason to doubt their accuracy. To the southern farmer some of the returns may not seem exceptional, but to one knowing the circumstances under which they were obtained they are very satisfactory indeed.

I would like to mention that, although the areas in many cases seem large in proportion to the number of cows kept, it must be understood that the land under natural conditions will give only a fraction of its maximum yield, either of crop or pasture. Only a small part of each farm is fully developed. The milking herds, and, in fact, most of the other stock are confined to the lucerne patches and sorghum plots for their food. I have endeavoured to obtain the area on each farm under these two magnificent fodders:—

FARM NO. 1.—AREA, 160 ACRES.

Pasture (natural grass) ...	75 acres	10 Dairy Cows.
Pasture (lucerne) ...	30 acres	140 Ewes and Lambs.
Cultivation (wheat) ...	50 acres	70 Lambs (sold).
Orchard and Garden ...	5 acres	10 Calves.
		7 Horses.
		30 Pigs.

Whilst no definite record was kept of the dairy herd, I was assured that the total return for cream for the season covering eight months was over £60. The calves reared are valued at the modest sum of 30s. each, and would represent £15; the whole of the pigs were reared on the place (no sales were effected during the season) and are now worth an average of 15s. each, or a total of £22 10s. The progeny of 100 ewes, viz., 110 lambs, some of which were sold at 12s. per head, equals £66, and to this must be added £28 net for the wool clip. The enhanced value of the ewes, which are now all fit for the butcher, should be estimated at least at another £20.

The area under crops was not looking promising, and was consequently cut for hay, of which there were 100 tons; this may be roughly valued at £2 a ton, representing £200 standing. It will, therefore, be seen that, whilst any of the different branches above-mentioned did not give abnormal yields, the total sum received was £441 10s. The labour of working this

farm, according to its area, would not require more than the services of a man and a boy. The cost of irrigation for crops is 2s. per acre if pumped, and 1s. if by gravitation; for lucerne land a similar charge is made, and for pasture (grass), 1s. and 6d. respectively. In the worst year three waterings are the most that are required, and usually the first two are by gravitation. As previously mentioned, the grass land is rarely watered, so the cost of irrigation on this farm would be confined to the cultivation and lucerne, costing £16 for water, and about £2 for labour in irrigating, leaving a net return of £393 10s. for the year's operations.

No account is kept of the return from the orchard or poultry, although both are said to more than pay their way. It will be noticed that seven horses are kept, and fed on this farm, from which no return is claimed. Three horses would be sufficient for the work of the farm, but the keeping of a number of idle horses seems to be the failing of the average northern farmer.

FARM NO. 2.

This is a farm of a much larger area, and consists of 600 acres. Two hundred acres are under lucerne, and 80 acres under barley, the balance being natural grass. The number of stock is:—Dairy cows, 65; calves, 60, dry cattle, 100; sheep, 600; pigs, 70. I could not obtain any details in this case, but was informed that for the months of October and November the cream cheques amounted to £20 per week, and at present are about £14 per week. My attention was drawn to two beautiful paddocks of lucerne, consisting of 30 acres, on which I was told 30 head of cows depastured for six months, and the only cost was one watering at 2s. per acre.

The annual return from the herd of dairy cows was estimated at £10 per head. If the weekly yields are taken into consideration, it will be seen for the month of October the cheques were £20 per week, which would represent a monthly return of £1 7s. per cow. Owing to the drought-resisting qualities of lucerne, and the capacity of the land to grow any kind of summer crops prolifically with the aid of irrigation, this district will keep the cows in a high state of productivity for a longer period than most of the southern districts.

FARM NO. 3.

No. 3 farm is situated on the Murray, about 6 miles from Swan Hill, and consists of 100 acres, the whole of which is under natural grasses. This farm is readily irrigated from the river up to November by gravitation, but last season only some 60 acres were irrigated once, at a cost of 6d. per acre.

The tenant commenced dairying, or at least the records were kept from the 1st August, 1905. The following statement shows the number of cows in milk for the different months, August, 1905, to February, 1906, and the amount received for cream:—

					£	s.	d.
August	... 12	cows—	586	lbs. butter ...	22	0	0
September	... 14	,,	622	,, ...	23	7	0
October	... 14	,,	617	,, ...	23	3	0
November	... 20	,,	783	,, ...	29	7	0
December	... 28	,,	800	,, ...	32	2	6
January	... 28	,,	595	,, ...	24	0	0
February	... 28		[illegible]	...	19	7	0

The total yield for cream alone amounts to £173 6s. 6d., and if the average number of cows is estimated, it will be found to be twenty, and the average return for each cow for the seven months under review would be £8 13s. 3d., truly a remarkable return from cows fed on natural pasture only. Whilst there were 28 cows on the farm, it would not be fair to debit the farm with that number until all were in profit, but after the first year this should be done. The above, however, demonstrates how prolifically the cows yield when in profit.

In addition to the return for cream, 27 calves, worth £40 10s., and 27 pigs, worth £1 per head, were reared, making a total return from 28 cows of £240 16s. 6d. for seven months. Assuming that the milk yield is but 7-12ths of the year's yield from the cows, another £123 16s. 1d. would be added, making a total of £297 2s. 7d. In one week in November, 239 lbs. of butter were produced, representing within a fraction of 12 lbs. per cow for the week.

As before mentioned, no artificial fodders were grown, but should a proportion of this farm be devoted to lucerne and sorghum-growing, the carrying capacity would be doubled, with the aid of irrigation. The cows are of mixed breeding, but are chiefly too beefy in appearance to be high-grade dairy cows.

FARM No. 4.

This farm consists of 320 acres, all under natural grasses, and has a frontage to the river Murray. Two hundred acres were irrigated by gravitation last November at a cost of 6d. per acre, the labour involved costing another 6d. per acre.

The total number of dairy cows on the farm is 27. Up till June, 1905, only eighteen were milked; six heifers were then purchased, two of them calving the same month, two in July, and two in August. Three more cows in profit were purchased in October.

The following are the monthly returns for cream sold during 1905:—

	No. of cows.	£	s.	d.		No. of cows.	£	s.	d.
January	18	14	9	5	August	22	21	12	8
February	18	13	9	10	September	24	32	3	8
March	18	12	2	8	October	27	31	8	9
April	18	13	12	6	November	27	27	0	0
May	18	7	4	10	December	27	34	6	6
June	18	6	18	3					
July	20	12	15	10	Total	...	£327	4	11

If the actual average of cows in milk in the above is estimated, it will be found to run out at 21 cows for the whole year, and the average yield from the cows would be close up to £11 per head. Although the average is 21 cows, it would not be fair, in this case also, to debit the herd with cows that were not on the farm during the whole of the year. As already stated, nine were added during the second half of 1905.

The cows milk for ten months each year, and even then great difficulty is experienced in drying them off. No special attention was given the cows on this farm; lucerne or sorghum is not grown, so the cows had to depend entirely on the natural pastures. The milking was done by the farmer, assisted by a boy and a girl; the latter was engaged to assist

The area of the farm may appear large for a return of £227 14s. 11d., but other stock were fattened at an estimated profit of £40. Twenty calves, valued at £30, were reared, bringing the total up to £297 14s. 11d. This, however, is only a fraction of the possible yield of land under a system of closer cultivation, and growing of lucerne and other green fodders, for which the district is so splendidly adapted. The owner assured me that if the land was under lucerne and properly attended to, *one dairy cow could be carried for every two acres of pasture.* This is not a high estimate of the carrying capacity of this class of land under proper treatment, and it is the opinion of many that if proper records could be obtained it would be found that in many instances one cow to the acre is carried.

GARDEN NOTES.

J. Cronin, Inspector Vegetation Diseases Acts.

The Bouvardia.

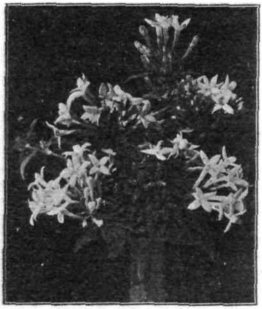
The bouvardia is a dwarf, shrubby, perennial plant specially suitable for planting in small gardens. The original species are natives of Mexico, and have been grown as green-house plants in England and Europe for more than a century, one species, *triphylla*—still to be found in our gardens—flowering for the first time in England in 1794. The types are rarely grown now, having been superseded by varieties raised by hybridists that are superior in every way. The flowers are larger, the habit of growth larger and sturdier, and the colours much more varied.

In Australia the bouvardia is practically a hardy plant, thriving well under the ordinary conditions that govern border cultivation. The plants are in some districts denuded of their foliage and the growths cut back by frost, but under fair conditions invariably break away into growth again in the following spring. For effect in the garden during autumn and early winter there are few shrubs more valuable than the bouvardia, the neat little bushes producing quantities of showy flowers for a long time. The flowers are valuable for table and other room decoration, the colours of the best varieties being bright and distinct; some varieties are very fragrant; and the whole class is specially valued by florists on account of the suitability of the blooms for bouquets and sprays for personal adornment. Bouvardias are propagated from cuttings of the young shoots taken from plants forced into early growth in hot-houses. They require bottom heat to insure any certainty of the cuttings rooting. Cuttings of the roots will also produce plants, and a gardener without conveniences such as hot-houses or hot-bed frames would be more successful in such mode of propagation. Plants can be purchased cheaply from nurserymen, and in the winter could be sent in safety by post to a long distance. Any fair garden soil will suit bouvardias, that of a rather retentive nature being most suitable. In very light sandy soils, some loam or clay should be added for these plants. They will eventually grow into bushes about 4 feet in height and 2 feet in diameter, except in the case of Humboldtii corymbiflora, which is of larger and looser growth. Where the plants are required specially for supplying cut flowers, they may be planted

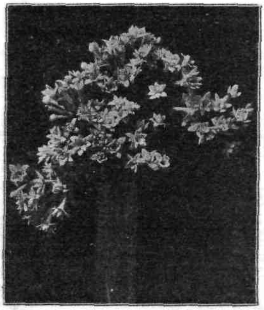
in narrow beds and protected from frosts by a shading of hessian or similar material. In preparing soil for the reception of bouvardias only well-decayed manure should be used, the addition of a little bonedust and fairly deep working being advisable, as under fair conditions the plants may last and give good results for possibly twenty years. Early spring is the best time to plant; if late frosts are usually experienced, plant later or shelter against frost temporarily.

The plants should be pruned fairly closely each year. If unsightly, some of the frost-affected growths may be removed in winter, but it is not wise to cut back to living wood until spring. Thinning out growths is important, or the plants will become tall and crowded.

Insect enemies of the bouvardia are brown scale, aphis, and mealy bug. Spraying with a strong solution of soft-soap and tobacco is the safest and



SINGLE-FLOWERED VARIETIES.



DOUBLE-FLOWERED VARIETIES.

most effective means of combating these pests. Working soot into the soil around the plants will deter the mealy bug and stimuate the growth.

Varieties:—Single-flowered—White, "Humboldtii" and "Humboldtii corymbiflora" (large flowers, very fragrant), "Beauty of Brisbane" (one of the best), "Candidissima" and "White Bouquet"; scarlet, "President Cleveland," "Hogarthii," "Elegans," and "Dazzler"; pink, "Maiden's Blush," "Bockii," "Priory Beauty," "Countess of Hopetoun," and "Miss Ida Cheeseman"; pale yellow, "Flavescens." Double varieties—White, "Alfred Neuner"; pink, "President Garfield" and "Australian Beauty"; scarlet, "Hogarthii flora-plena" and "V. Lemoine"; and pale yellow, "Flavescens flora-plena."

Flower Garden.

Pruning, planting, manuring, and digging constitute the most important work during July. Pruning is undoubtedly one of the most important tasks connected with gardening. The main objects are to produce large, strong, symmetrical plants; to regulate the size according to area, and to promote growths that will flower freely in advantageous positions or produce certain effects. To promote vigorous growth, most plants should be

pruned in winter; to regulate the ensuing growths, the plants should be disbudded, pinched, and regulated during active growth. The most commonly noticeable faults are—too many shoots or branches are generally allowed to remain; the vigorous shoots are pruned too hard, *i.e.*, too much is cut off the shoot; and the weaker shoots are pruned too light, and often not at all. In every case room should be allowed for light and air to penetrate to all parts of the plants, and only an even-size type of shoots or branches allowed to remain. Strong, straight shoots should always be cut clean away if the plant is healthy, otherwise the unhealthy wood should be removed and the strong growths manipulated to make a new head. By thinning out and lightly pruning the growths on vigorous plants, the unsightly bare stems so frequently seen are avoided. Newly-planted roses and deciduous shrubs lifted from the ground should be pruned hard at time of planting.

Digging is a more important operation than is usually considered. It should be not only the turning down and covering of weeds for neatness sake, but a thorough, even working of the soil, even distribution of manures and soils to improve the general staple if possible, and to break any hard layers that may have been formed during summer by the shallower operation of hoeing, and which are likely to prevent access of air and water to all parts of the beds. In digging among plants, great care should be taken to avoid damaging the roots. Weeds growing near plants should be skimmed off and dug deeply into the beds outside the root radius. The operator should have a narrow trench in front to the full depth of the digging, into which manure, weeds, small prunings, &c, can be easily turned. An even, but not smooth, surface should be aimed at.

Carnations will require attention in staking, tying, and thinning. Where the plants are encircled with mesh wire, thinning only is necessary. The tree varieties develop many side-growths, all of which, if allowed to remain, would unduly crowd the plants and tend to the production of inferior blooms. Inside shoots should generally be removed when thinning. Cuttings made from such shoots, planted firmly in sandy soil, are likely to "strike," and will grow into good plants for next season. Soot, if worked into the soil around the plants, will greatly aid the flowering and assist in keeping the plants healthy and free from slugs, &c. Dahlia tubers may be lifted and stored in a dry shed during winter. If the ground is of a nature that holds moisture, it is safer to lift them now than in spring. The preparation of the beds for next season's planting can also be proceeded with. If available, new ground should be selected, but if not, new soil and manure should be well worked into the beds before dry weather begins.

Bulbs of various summer blooming Liliums should be planted. No manure should be permitted to touch the bulbs, or they are sure to rot. In gardens in the country districts where manure is scarce, fine clumps of Lilium auratum, and other kinds, are often to be seen blooming splendidly where weeds refuse to grow. Amaryllis, and an early batch of Gladiolus, may be planted.

Hardy annuals may be transplanted. If seedlings—where sown to remain till flowered—are growing too thickly, they should be thinned out, and may make useful patches of colour later, if room is available for their reception after the beds are dug.

Kitchen Garden.

Sowing seed of various vegetables, planting out from former sowings, and preparing ground for future crop is generally the routine work during the winter months. Asparagus, onions, &c., should be transplanted, and sets of early potatoes planted in early situations. Seeds of onions, peas, broad beans, cabbage, and other vegetables that will be required during the spring months may be sown.

Those who intend to raise tomato plants in heated beds should prepare the manure, &c., for the purpose. Fresh stable manure, with plenty of straw, is needed, and it must be watered, stacked to ferment, and turned at least twice to insure an even heat, without which it would be useless to attempt the raising of delicate plants. Dry, open, sunny positions should be selected for such beds, with some protection from cold winds.

THE ORCHARD.

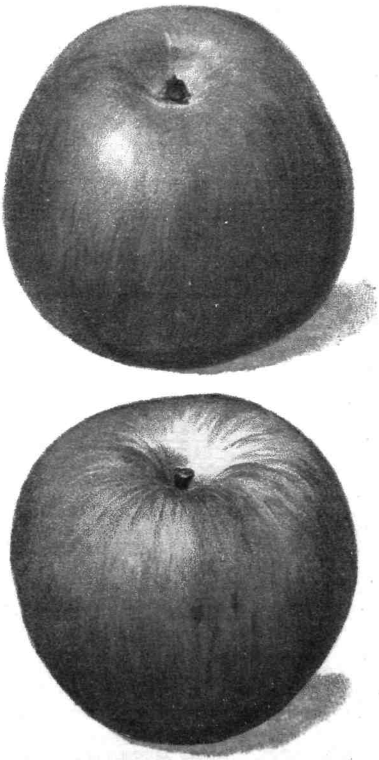
James Lang, Harcourt.

In last month's number of the *Journal*, the best apples suitable for export were enumerated. The best varieties of pears for export are now furnished for the information of orchardists.

Winter Nelis has so far given the best results. It is generally landed in fairly good condition, and, being also a pear of the first quality, realizes a high price. Exception may be taken to this variety on account of it being a shy bearer in some districts, but this is due in a great measure to faulty pruning. The tree has a tendency to form too many fruit spurs, and so exhausts itself in blooming; but if the fruit spurs are well thinned out at pruning time, the result would be a more satisfactory setting of fruit. Josephine de Malines is also one of the best varieties, and when landed in good condition realizes a high price. Beurre d'Anjou is another good export pear, and so also are Beurre Clairgeau, and Bretonneau. Eyewood, generally called Broompark, from which it is quite distinct, is also suitable for export. Glou Morceau also carries well, and sometimes brings a high price. Vicar of Winkfield has been shipped in large quantities, and has been on the whole fairly successful. This is only a second-rate pear, as far as quality is concerned, but it is a regular and constant bearer.

The foregoing varieties have so far proved themselves to be the best export pears, but the conditions under which pears have been carried by the various shipping companies leave room for a good deal of improvement. Pears require to be carried at a much lower temperature than apples, as near as possible 35 degrees Fah. From reports to hand, the past season has been a disastrous one for pear shippers, consignments in most cases arriving in a rotten and absolutely worthless condition, owing to being carried at too high a temperature, or in some cases allowed to get frozen. A good trade could be done with pears if the carrying conditions were more reliable.

The fruits specified in the following lists are suitable for planting, either for market or for home consumption, and are arranged in their order of ripening.



JONATHAN.

Apples.—Williams' Favourite, Gravenstein, Emperor Alexander, Green Alfriston, Jonathan, Reinette de Canada, London Pippin, Esopus Spitzenberg, Munroe's Favourite, Cleopatra, Rome Beauty, Rymer, Stone Pippin, Rokewood.

Pears.—Williams' Bon Chretien, Doyenné, Boussoch, Gansel's Bergamot, Poire de Berriays, Beurre de Capiaumont, Beurre Hardy, Beurre Bosc, Marie Louise, Beurre d'Anjou, Eyewood, Winter Nelis, Josephine de Malines.

Plums.—Early Rivers, Early Orleans, Angelina Burdett, De Montfort, Diamond, Grand Duke, Washington, Yellow Magnum Bonum, Pond's Seedling, Coe's Golden Drop.

Apricots.—Oullin's Early Peach, Royal, Hemskirke, Mansfield Seedling, Moorpark, Dundonald.

Peaches.—Amsden's June, High's Early Canada, Alexander, Brigg's Red May, Hale's Early, Crimson George, Royal George, Elberta, Foster, Prince of Wales, Lady Palmerston, Salway.

Cherries.—Early Purple Guigue, Burgdoff's Seedling, Twyford Bigarreau, Early Lyons, Eagle's Seedling, Black Bigarreau, Bedford Prolific, Biggareau Napoleon, Florence, St. Margaret.

Figs.—White Genoa, Large Black Genoa.

Currants.—Black Naples, La Versaillaise (Red), Carter's Black Champion, Bertyns No. 9.

Strawberries.—Edith, La Marguerite, Up-tut-mark, Trollope's Victoria.

Pruning should be taken in hand at once, and pushed on until completed.

DESCRIPTION OF APPLES.

James Lang, Harcourt.

Jonathan.

Fruit medium size, conical and regular in its outline, about 2½ inches in diameter, and 3 inches high. Skin covered with bright red, becoming dark red when fully exposed to the sun, a brilliant and beautifully coloured apple. Flesh white, tender, and juicy, with a good flavour; eye closed, set in a deep rather broad basin; stalk about three-quarters of an inch long, set in a deep and regular cavity.

In season from February till June. The tree is rather a moderate grower, making slender wiry wood of a greyish brown colour; it comes into bearing early, and is a regular and good bearer.

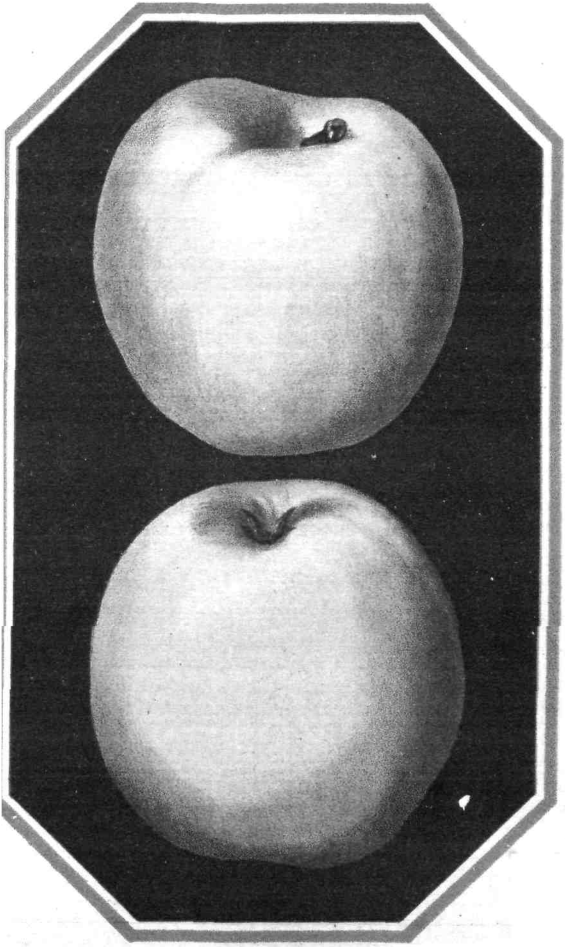
Downing says: "The original tree of this variety is growing on the farm of Mr. Philip Rick, of Kingston, New York. It was first described by the late Judge Buel, and named by him in compliment to Jonathan Hasbrouck, of the same place." It was introduced into Victoria by the Royal Horticultural Society about thirty-five years ago, and has become one of the most popular varieties with all market growers.

The variety first introduced as Jonathan, when it fruited, turned out to be Esopus Spitzenberg, while the true Jonathan was introduced under the name of Marston's Red Winter. This gave rise to great confusion amongst the experts; to settle the matter the Jonathan was again imported from America, when it proved to be the same variety previously introduced as Marston's Red Winter.

Cleopatra, or New York Pippin.

Fruit medium size, about 3 inches wide at the widest part and 3 inches high, conical, even and regular in its outline. Eye closed, set in a small deep corrugated basin; stalk long and slender, set in a deep funnel-shaped cavity, which is generally of a green colour. Skin green, covered with small white specks; when fully ripe it is of a beautiful clear lemon-yellow colour with a fine clean skin—a most beautiful apple. The seed cells are often surrounded by a large hollow cavity, which sometimes causes decay; flesh white, tender, and juicy, with a fine sprightly flavour. It is in season from February till November, and is one of the best and longest-keeping apples. This variety is subject to bitter pit, especially on young trees, and on larger trees on which there is a light crop. Where the trees are bearing a good crop the fruit is generally clean and good. It is also subject to the scab (*Fusicladium dentriticum*), and should be carefully sprayed with Bordeaux mixture. This is one of the very best apples for export, especially in the warmer districts of the State, as it is one of the earliest export apples to mature; it can be shipped early in February. Although the fruit may not have grown to its full size when picked, it will still ripen and colour without shrivelling, if kept closely packed. The origin of this valuable apple is unknown. It seems to have been first introduced into Victoria from Tasmania. The trees in an old orchard at Harcourt, planted in 1855 or 1856 by the late Captain Smith, R.N., at that time Warden of the Castlemaine Goldfields, were obtained from Tasmania, and amongst them were some trees of the New York Pippin. Mr. L. M. Shoobridge, Glenora, Tasmania, writes me: "I had some trees in a garden planted about 80 years ago, and there were some New York Pippins in it, so it is evident that the variety has been long established here. I do not think it is a Tasmanian seedling."

This variety seems to have been known in the early days under the name of the New York Pippin; how, or when, it became known as Cleopatra the writer has been unable to ascertain. At one time it went under the names of Pomme de Roi, Pomeroy and Spanish Reinette. The late Mr. George Neilson, F.R.H.S., held strongly to the opinion that it was identical with the variety known in America as Ortley. To settle the question the Department of Agriculture imported that variety with some others from America, but, unfortunately, just when the trees arrived, Mr. Neilson resigned his position as Curator of the Burnley Gardens, and so the matter was lost sight of. Notwithstanding its drawbacks, this is one of the most valuable apples for export, and should be largely grown for that purpose. In Tasmania and South Australia it is also one of the leading export apples.



CLEOPATRA.

DISEASES OF FARM ANIMALS.

S. S. Cameron, M.R.C.V.S.

V.—NOTIFIABLE DISEASES UNDER THE "MILK AND DAIRY SUPERVISION ACT 1905."

By the coming into operation of the *Milk and Dairy Supervision Act* 1905 on July 1st, 1906, certain diseases of animals are created "notifiable diseases"; that is, the fact of occurrence of any of these diseases in the State of Victoria has to be notified to the Department of Agriculture by the owner or the veterinary surgeon in attendance. Failure to notify constitutes an offence against the Act, and renders the owner or veterinary surgeon liable to a penalty not exceeding £5 for a first offence, and not exceeding £50 for any subsequent offence.

The sections of the Act specifically referring to notifiable diseases are as follow:—

"20. The following shall be notifiable diseases of animals under this Act:—

Anthrax,
Black leg or symptomatic anthrax,
Contagious mammitis,
Contagious pleuro-pneumonia,
Contagious abortion,
Swine fever,
Tuberculosis,
Variola vaccinia, and

Any disease which may from time to time be proclaimed by the Governor in Council by order.

"21. (1) When any animal at a dairy farm or dairy is affected with any notifiable disease the owner thereof shall immediately notify the fact in writing to a supervisor* or a member of the police force and in the notice shall state—

(*a*) his name and address,

(*b*) the address of the dairy farm or dairy where such disease exists,

(*c*) the kind of animals and number of animals affected with such disease.

(*d*) the name of such disease, and

(*e*) any action that has been taken in pursuance of the provisions of this Act with regard to every such diseased animal.

"(2) Such owner shall at once isolate any and every such diseased animal and shall unless otherwise prescribed keep any and every such animal isolated while such disease continues or as long as there is reason to think in the case of any cow so affected that there is danger of the milk of such cow being infective or contaminated or deteriorated as a result of such condition having existed.

"The word 'isolate' means the keeping of an animal in a separate enclosure in such a manner as to prevent actual contact of such animal with any cow being used for production of milk or cream for sale or with any animal having contact with such cow.

* All such communications should be forwarded direct to the Chief Veterinary Officer, Department of Agriculture, Melbourne.

"(3) Every registered veterinary surgeon or other person treating animals for disease upon it coming to his knowledge in the course of his practice that any animal is suffering from or is affected by any notifiable disease shall at once notify the authority of such occurrence.

"(4) A fee of Five shillings shall be paid by the authority to such owner or veterinary surgeon for such notification if the authority is satisfied that the report is correct. Only one such fee shall be paid in respect to any single outbreak of such disease."

Anthrax.

(*Synonyms. Cumberland Disease—splenic fever—splenic apoplexy—black rot.*)

Anthrax is the most ancient contagious disease of animals that is known. The sixth plague of Egypt referred to by Moses, was anthrax, and elsewhere he indicates the transmission of the disease from cattle to man by means of soiled clothing. Homer, Ovid, Plutarch, Dionysius, Livius and other ancient writers frequently refer to this disease; and in some cases their descriptions are most exact and plainly manifest the disease as we know it now-a-days.

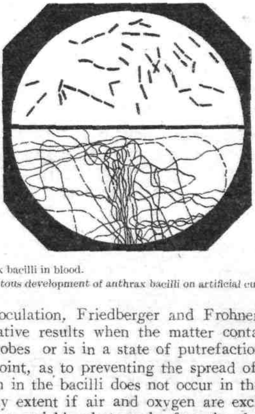
Anthrax exists in most countries of the world and has been prevalent throughout Australia for a long period, affecting cattle and sheep principally but horses and pigs in lesser degree. In New South Wales it was known prior to the seventies as Cumberland Disease (from its particular prevalence in the County of Cumberland) and the credit of definitely identifying and announcing this disease as anthrax belongs to the late Graham Mitchell, F.R.C.V.S., of Melbourne. Early in 1876 there was great mortality of sheep in the Western District of Victoria which was recognised as being analogous with Cumberland disease and identified by Mitchell as anthrax. His announcement was, however, officially discredited, much bitter feeling being engendered, and it was not till after Mr. Mitchell's death in 1888 that the correctness of the diagnosis was publicly admitted. A detailed history of the controversy on the subject, which was a lengthy one, is given in a brochure on "Cumberland Disease in Australian Sheep" published by Graham Mitchell in 1877.

DEFINITION.—An acute contagious febrile blood disease, affecting herbivorous and omnivorous animals (including man) principally, caused by the *bacillus anthracis*, and characterized by a general hæmolysis with engorgement of the spleen and other organs and by sudden onset, rapid course and almost uniformly fatal termination.

CAUSATION.—The *bacillus anthracis* was discovered in the blood of animals dead of the disease in 1850 by Davaine, and was demonstrated by him to be the specific cause of the disease thirteen years later (1863). It was the first disease-producing organism to be recognised, and the science of bacteriology may be said to date from its discovery. Usually, but not without exception, it is found in the blood of all parts of the body and in the spleen and other organs. Compared with others since discovered it is a large bacillus (5 to 20 microns long by 1 to 1.15 microns thick) and is distinctly rod-shaped with square ends. It is non-motile, aerobic,

stains by Gram's method or any aniline dye and grows freely on a variety of culture media. Grown outside the body it assumes a filamentous form and bears spores which are particularly resistant to extremes of temperature.

The anthrax bacillus is quickly destroyed in the presence of putrefaction and septic ferments, and as decomposition of an unopened anthrax carcass is very rapid the search for the bacilli may be fruitless if the examination is delayed till putrefaction is advanced. Not only may the bacilli not be found by microscopic examination, but the blood and tissues will not be infective to other animals after a few days except in those cases where, through admission of air, the bacilli have sporulated. In such cases the bacilli would have become disintegrated but the spores would produce anthrax in any susceptible animal inoculated. This fact has an important bearing on the diagnosis of the disease and also upon the suppression of its spread. It will be obvious that microscopical and bacteriological methods of diagnosis cannot be relied on except when the examination is conducted on comparatively fresh specimens, taken in a manner to minimize risk of contamination with putrefactive organisms.



A. Anthrax bacilli in blood.
B. Filamentous development of anthrax bacilli on artificial culture.

Even as regards inoculation, Friedberger and Frohner set out that "inoculation gives negative results when the matter containing the bacilli is soiled by other microbes or is in a state of putrefaction."

On the second point, as to preventing the spread of the disease, seeing that spore formation in the bacilli does not occur in the living animal nor in the carcass to any extent if air and oxygen are excluded and that the bacilli themselves are quickly destroyed after the death of the animal, it follows that the risk of spread of the disease is greatly lessened if the carcass is not cut or opened up to contact with air. The germs are imprisoned, so to speak, and die from oxygen starvation. Any risk there is lies in the possibility of the discharges from the carcass containing bacilli which, on contact with the air form spores by which the contagion may be propagated. If, however, such discharges are collected and burnt along with the carcass, or buried deeply with it, the risk of spread of anthrax may be reduced to a minimum. It is this quick destruction of the bacillus by decomposition and the absence of sporulation that accounts for that sudden cessation of an anthrax outbreak which is so frequently

observed and which appears so inconsistent with the expected behaviour of a contagious disease.

When the bacillus has become liberated from the carcass it may be preserved in the soil and propagate for an almost indefinite length of time. This is more likely to occur if the soil is rich in organic matter, and hence moist alluvial lands are notoriously more retentive of anthrax infection than dry uplands. A paddock with anthrax-infected soil may not produce anthrax for years, until the occurrence of conditions which favour the transmission of the germs from the soil to the herbage. In very damp seasons the germs may be brought to the surface by the elevation of the water level on swampy ground; or they may be washed out by floods and deposited on the surface; or the excessive moisture may bring up earth worms whose earth casts may contain bacilli from an anthrax grave or infected soil; also grass or plants springing from deeply-buried seed and pushing up through rain-loosened soil may carry bacilli to the surface on their growing leaves. Again, anthrax may occur in very dry seasons when infected water-holes, swamps and morass land dry up and leave the germ-mixed mud accessible to stock. A growth of vegetation springs up on the mud coating, and stock often pull up such vegetation by the roots and so run further risk. Flies and insects of various kinds are also much more numerous during the dry summer season, and they are undoubted carriers of contagion.

Method of Infection.—It will have been gleaned from what has been said about infection from pasturage that one of the principal ways in which the germ gains entrance to the system is in the food by *ingestion*. In addition to pasture, hay or other fodder grown on infected land is a frequent cause of anthrax breaking out on previously uninfected properties. In New Zealand anthrax in sheep has been traced to the feeding of growing root crops, in which case the likelihood of ingesting soil along with the food is very great. Root crops that have been manured with bone-dust supposed to have been contaminated with anthrax germs have been particularly blamed. Since the investigation of this phase of the subject by Mr. J. A. Gilruth, M.R.C.V.S., the New Zealand Government Veterinarian, imported Indian bone-dust has been held responsible for a number of outbreaks in Victoria and elsewhere throughout Australia.

Inoculation is another method of infection, flies and insects conveying the germs from anthrax carcasses to wounds and abrasions on other animals. Inoculation may also occur through accidental wounds made with knives and instruments previously used on an anthrax carcass; in fact, this is the most common way in which man becomes infected with the form of anthrax known as "malignant pustule."

It is questionable whether the disease in animals is ever caused by Inhalation, but in man the pulmonary anthrax called "woolsorters' disease" is most likely caused through inhalation of the particles contaminated with anthrax germs which rise when dried skins, hides and wool are being handled.

Forms of Anthrax and Symptoms.—As a general infection anthrax occurs in hyper-acute, acute and sub-acute forms. The first of these is more usually described as *Apoplectic or Fulminant* anthrax. The animals, cattle or sheep mainly, are affected suddenly without premonitory symptoms; they have convulsions and die in the course of from a few minutes to an hour. The earlier cases in the anthrax outbreak at Keilor, Victoria,

in the beginning of 1903 were of this form, some of the cows being found dead within an hour of their having been observed feeding and apparently perfectly well. Others were seen to suddenly stop feeding, look round wildly, stagger and fall as if in a fit and die after struggling for a few minutes. The fulminant form of anthrax appears to afford an illustration of the phenomenon observed by various investigators that the bacilli are less numerous in the blood in proportion to the more rapid course of the infection. Quite often in these cases the bacteriological examination of the blood gives negative results because the bacilli are located or colonized in one particular organ or spot; they have not time to multiply to an extent sufficient to pervade the whole body before death results from the lethal effects on the central nervous system of the anthrax toxin formed locally.

ACUTE GENERAL ANTHRAX is a little less rapid. Death occurs in from two to twenty-four hours. During this time there is high fever with increase of temperature, tremors, excitement, grinding of the teeth, groaning, stupefaction or frenzy, staggering gait, spasms, laborious breathing, prostration and finally the convulsions which precede death. There may be great straining to pass fæces and urine, with frothy and blood-tinged discharges from the natural orifices. Emphysema or a gaseous distension under the skin may also be observed.

SUB-ACUTE GENERAL ANTHRAX.—In this the features are somewhat similar to those of the acute form only that the course is less rapid and the steps from one set of symptoms to another are more prolonged and defined. There may be intermission of symptoms for a time and the fatal culmination does not usually occur until the lapse of 36 or 48 hours, and it may be postponed for five or even seven days.

GLOSS-ANTHRAX.—In horses and pigs anthrax often assumes a local form affecting the tongue and region of the neck and throat. These become swollen and there may be also swellings on the shoulder flank and thigh which are at first hard, hot and painful and later on become doughy, fluctuating and cold. The tongue is greatly enlarged and blackened and may protrude from the mouth. There is inability to swallow and great difficulty in breathing.

POST-MORTEM APPEARANCES.—The carcass has a tendency to swell quickly, decomposition of the abdominal contents being very rapid. There is also a gaseous distension (emphysema) under the skin which on pressure gives out a crackling sound. Blood-tinged fluid effusions are noticed under the skin. In what may be described as typical cases but to which there are many exceptions the blood is profoundly changed, being black in colour and remaining black on exposure to air. It does not clot freely and has a tarry appearance. The lining membrane of the chest and abdominal cavities is dotted with patches of blood extravasation (ecchymosis) as also are the heart sac, the kidneys and the liver. The heart and large veins leading from it are filled with black liquid blood and the heart muscle is soft and relaxed. The lymphatic glands are always congested and may be spotted with hœmorrhages. The liver is usually enlarged, soft, friable and easily broken down. The lungs are engorged with blood and dropsical. The trachea and bronchial tubes contain bloody mucus. The mucous lining of the stomach and bowels is reddened and spotted with blood extravasations. In the spleen the most decided changes are observed. It is enlarged to two or three times

its natural size, and its structure or spleen pulp is softened, broken down and heavily charged with blood and fluid of a deep colour.

The appearances described are not likely to be all met with in every case, in point of fact "in the rapidly fatal cases the changes in the blood and tissues are often little marked" (Law); but even in fulminant anthrax there may usually be found localizations of the described appearances in some organ or group of lymphatic glands where colonization of the bacilli has occurred, and blood or tissues from such part will be found loaded with bacilli.

PREVENTION.—The carcasses of animals dead of anthrax and all matter likely to have become contaminated should be dealt with in the manner described under the headings "Disposal of Carcasses" and "Disinfection" in the chapter on Prevention of Disease. Lands upon which anthrax has become "enzootic," *i.e.*, where the soil is impregnated with the bacilli and the disease breaks out periodically, should if possible be turned from grazing use for a time and cultivated. The underdraining of low-lying, damp land is also to be recommended, not only because of the removal of stagnating moisture but also because of the soil aeration which draining effects. Under the slow influence of oxygen, anthrax bacilli are gradually robbed of their virulence. Seeing that anthrax is not usually conveyed from animal to animal by direct contact but is most often contracted from the pasture or food, a practical measure towards the prevention of its spread is the removal of all apparently healthy animals from the paddock in which the disease has been occurring to dry upland country. The mortality will almost at once cease, and even if an odd animal does succumb after removal the risk of contaminating the new paddock will be small if the precautions previously mentioned, as to disinfection and the non-opening of the carcass before burning or deep burial, are strictly observed. Besides, the anthrax germs are not likely to become permanently fixed on dry sandy soils.

PREVENTIVE INOCULATION.—Immunization of flocks and herds by inoculation with an "anthrax vaccine" has been practised for many years with varying degrees of success. Some of the "vaccines" used consist of an attenuated or weakened culture of the bacillus and others of sterilized anthrax toxins. They are prepared in various ways—(*a*) by the action of heat (Toussaint), sunlight (Arloing), compressed oxygen (Chauveau) or antiseptics (Chamberlain and Roux); (*b*) by the cultivation of the bacillus in an oxygen atmosphere (Pasteur); and (*c*) by sterilizing anthrax blood and dissolving out the soluble toxins (Law).

Pasteur's method is the one that has given the best results and by it protective virus of two grades of virulence are usually used. The first is a very weak virus ("1st vaccin") resulting from cultivation in oxygen at a high temperature (42 degrees C.), to prevent the formation of spores for twenty-four days. The second or stronger virus ("2nd vaccin") is got when cultivation under the same conditions is carried on for twelve days. To inoculate, the prescribed dose of 1st vaccin is injected under the skin on the inner aspect of the thigh (sheep) or behind the shoulder (cattle) and fourteen days later the 2nd vaccin is similarly injected. The dose must be regulated according to size and age, but the average is ⅛th of a cubic centimeter for sheep and double that amount (¼th c.c.) for cattle. The protection lasts for about a year or more, after which re-inoculation is necessary.

It cannot be confidently recommended to practise inoculation for anthrax indiscriminately. It should never be practised except on anthrax lands, that is where the disease occurs periodically as an enzootic, as "elsewhere it may lead to the stocking of a new area with a maglignant germ (the anthrax bacillus) which in young and susceptible animals re-acquires its original virulence." Another drawback as regards sheep is that different breeds and families appear to possess a very irregular sensitiveness to the same virus; hence, in large part doubtless, the many fatalities that result from inoculation of sheep on the one hand and the many failures to protect on the other. In Australia the best results are obtained between May and September.

Law's method of anthrax protection by injection of sterile solution of anthrax toxins has been practised with success in America. The blood of an anthrax animal is heated for half-an-hour at 212 degrees F. to destroy the germs; it is then washed with boiled water to dissolve out the toxins, and the resulting solution is injected in doses of 2 to 4 c.c., as the protecting virus. The advantages claimed are:—(*a*) That the material can be prepared on the spot when dealing with an outbreak; and (*b*) that as the germs are destroyed, the risk of inoculating virulent anthrax or introducing it to a new area is avoided.

Blackleg.

(*Synonyms. Black-quarter—Quarter-Ill—Symptomatic Anthrax—Emphysematous Anthrax.*)

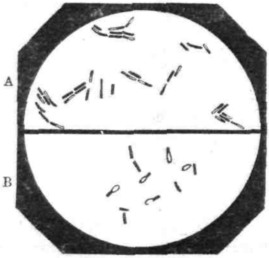
DEFINITION.—An acute infectious febrile disease, affecting almost solely young cattle, caused by the *bacillus Chauveauii* and characterized by fever, lameness and hot, painful swellings on the quarter, thigh, neck, shoulder or elsewhere which tend to become emphysematous and gangrenous.

This disease has only become prominently prevalent throughout Australia during recent years. It is a disease so common in England that it would be well known to imported veterinarians, and its occurrence would scarcely have escaped their notice, yet it was not till the late nineties that its existence was chronicled. Since then it has been the cause of considerable mortality amongst calves and young stock in many dairying districts. The incidence of the disease is practically confined to young cattle between the age of three months and two years. It seldom, if ever, attacks calves while still on a milk diet solely; this because of the fact that the germ is usually introduced from the soil when grazing.

NATURE AND CAUSATION.—For a long time blackleg was looked upon as a modification of anthrax but it is now known to be caused by a different bacillus, and while it has many features of an anthracoid character its clinical history, local symptoms and age period of incidence serve to easily differentiate it from true anthrax.

The actual cause is a bacillus, called the *bacillus Chauveauii* or *bacillus anthracis emphysematosus*, having the following features:—Rod-shaped with rounded ends one end being often larger than the other on account of the presence of a spore, so making the bacillus club-shaped. It is anærobic, living in the tissues without utilizing the oxygen of the blood and being but rarely found in the blood in which oxygen is abundant;

motile, the movements being both undulatory and rotary; and sporulates within the body. It withstands putrefaction, and is found abundantly in the tissues a long time after death, even up to six months. A reference to the description of the anthrax bacillus will show that in regard to all the features just mentioned the bacillus of blackleg is the direct antithesis of the anthrax bacillus. Like the latter, however, this bacillus persists in the soil for an almost indefinite period and blackleg can be readily produced by inoculating the washings of marshy soils that have been contaminated a long time previously. The disease occurs under the same conditions and on the same class of country as anthrax. An obvious preventive measure, therefore, is to avoid depasturing young cattle on wet clayey or marshy soils during the age period of this disease. It would seem to be necessary for there to be wounds or scratches of the mucous lining of the mouth or alimentary tract before the disease can be contracted, for it is probably only conveyed by inoculation. In this connexion it is significant that the age period of the disease is synchronous with dentition changes, and it is likely that in the great majority of cases the inoculation



A. Bacillus of blackleg.
B. Bacillus of blackleg showing drumstick development.

occurs through the raw edges of the gums when the milk teeth are being cast. Pasturing on scrub or on spear grass or other rough herbage is also likely for obvious reasons to predispose to the contracting of the disease.

Lack of vigour through high condition on the one hand or through poverty on the other is a noticeable auxiliary cause, as also are chills and sudden changes of weather during the spring when young stock are shedding their winter hair.

SYMPTOMS.—The period of incubation or time elapsing from inoculation to the manifestation of symptoms varies from one to five days, the average being two days. The animal then becomes dull, feverish and depressed; there is loss of appetitie and rumination, and a marked increase of temperature. A stiffness or lameness in walking is then observed. This is usually confined to one limb and there quickly succeeds a swelling or tumefaction of the affected limb or of some other part of the body. The swelling is small at first but extends very rapidly and may acquire a considerable size in a few hours. It is hot and painful,

and when rubbed or pressed with the hand a crackling noise is heard due to the distension of the tissues beneath the skin with gas. Later the swelling becomes cold and insensitive, and on being lanced a dark-red frothy and offensive fluid exudes along with bubbles of gas. As the disease advances the animal rapidly weakens, the breathing becomes very distressful and, preceded by a rapid fall of temperature, death results in from one to three days.

POST-MORTEM EXAMINATION.—The carcass—the internal organs as well as the tissues underlying the skin—will be found greatly bloated or distended with gas. The tissues in the region of the swelling are engorged with dark, frothy blood; they are friable, breaking down readily under finger pressure and have a bruised pulpy appearance. The bacillus is present in this pulpy mass in large numbers. The lymphatic glands in the neighbourhood are enlarged and congested. The lungs, liver and kidneys are also usually congested but the spleen is rarely enlarged.

PREVENTION.—Recovery practically never occurs and curative treatment is useless so that quick destruction of all cases definitely diagnosed as blackleg is a wise procedure. The carcasses should be burnt and the disinfection methods and other preventive measures recommended in anthrax cases and for infected areas should be carried out in every detail. Cultivation of infected land is more successful in eradicating blackleg than anthrax, the aeration of the soil effected by the cultivation operations being inimical to the development of the anaerobic germ.

PREVENTIVE INOCULATION.—Immunity against blackleg can be produced artificially by subjecting the system of an animal to the action of the weakened toxins of the bacillus. This may be done by different method but that which has been most successful is the use of a weakened virus or "vaccine" prepared from the diseased flesh according to the method of Arloing. "Forty grammes of the diseased muscle are dried rapidly at 32 degrees C. (90 degrees F.) and triturated in 80 grammes of water. This is divided in 12 equal parts and put on plates in two thermostats, six at 100 degrees C. (212 degrees F.) and six at 85 degrees C. (185 degrees F.) where they are kept for six hours, when it forms a dry, brownish powder. One-tenth of a gramme ($1\frac{1}{2}$ gr.) of this powder is dissolved in five grammes of distilled or boiled water and will furnish ten doses. The animal to be protected is first injected in the tip of the tail or elsewhere with the virus prepared at 100 degrees C., and ten days later with that prepared at 85 degrees C." (Law.) A peculiar fact about the weakened virus so prepared is that its full virulence is regained by the addition to it of a small quantity of lactic acid.

The Pasteur Institute prepares the vaccine, and issues it in the form of short threads that have been soaked in a virus of required strength and afterwards dried. The threads are introduced under the skin by a special needle after the manner commonly practised in inoculation for pleuro-pneumonia. An American firm also distributes virus prepared by the Arloing method but in the form of solid pilules which are injected under the skin by means of a syringe fitted with a canula, needle and spring piston.

For the successful prevention of the disease on infected farms or in infected districts all the young cattle between three months and two years old should be inoculated in the spring and autumn. The two inoculations are necessary because the protection which it conveys only lasts about six months.

It should be mentioned that this method of immunizing stock against blackleg should be restricted to cattle on infected areas otherwise there is grave risk of introducing the disease into new country. Such risk is much greater if the inoculation is carried out during the hot summer season.

In New South Wales also blackleg is a notifiable disease, the penalty for failure to report being £50, and for selling or purchasing stock affected with it the fine is £100. Under the *Noxious Microbes Act* 1900 preventive inoculation by private owners without a licence from the Chief Inspector of Stock constitutes an offence.

THE MALLEE FRONTAGE OF THE MURRAY RIVER.

An Undeveloped Province of Victoria.

(Continued from page 266)

A. S. Kenyon, C.E., Engineer for Agriculture.

The Lands Around Mildura.

Carwarp, already referred to in connexion with the Nowingi country, lies immediately above the Mildura Concession. Since the first part of this article was published, the Victorian Government has decided to establish a settlement at Carwarp, along with the Nowingi lands, on lines laid down in a joint memorandum by the Surveyor-General, the Director of Agriculture, and the Engineer for Agriculture. These officers consider that the Mallee frontage may be successfully settled under special conditions suited to the locality. To quote their exact words:—

"We consider that its successful settlement can only be expected under the following conditions:—All homesteads to be on the river frontage in settlements of from twenty to fifty families, each homestead block to consist of about forty acres, of which twenty would be irrigated annually. Plant and works to be constructed and managed by the Government. Each settler to have a considerable area, from 400 acres upwards, of the interior land. This large block would be utilized for wheat-growing and grazing, as seasons permitted. The title for the homestead and wheat-growing blocks should be inseparable, and improvement conditions of a stringent character should be enforced. Residence on the homestead irrigation block, and systematic cultivation of the wheat block to be made compulsory. The limitation provisions of the Closer Settlement Act as to transfers of titles and continued application of residence conditions to apply.

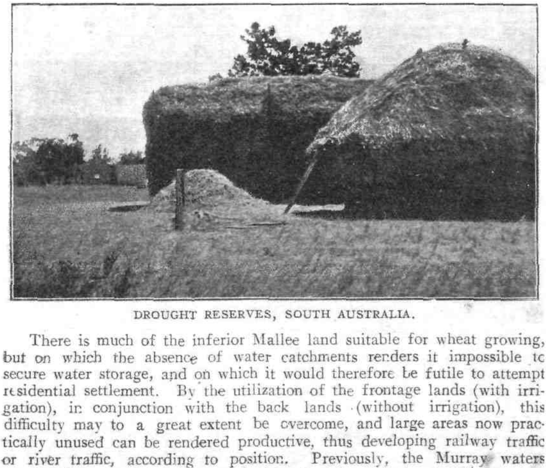
Care will be required in the selection of suitable settlers. Terms of payment should be made easy in the early years, and charges for irrigation should be levied. The Crown Lands charge for the land to be on the basis of its value, subject to irrigation advantages, but otherwise unimproved.

Carwarp, some thirty miles by the frontage track from Mildura, and ten from the Nowingi railway station, has been selected as a site to recommend for a first settlement. It forms part of an area reserved by the

Victorian Water Supply Department as an irrigation block, but since relinquished by it. The Nowingi subdivision of good land, suitable for wheat-growing but not capable of supply with permanent water, is within reasonable distance of Carwarp, and close to the railway line.

An area, containing about 1,800 acres, fronting the river at Carwarp has been roughly levelled and its suitability for irrigation ascertained. The cost of pumping plant, channelling, &c., may be estimated at £5,000, and this would suffice to supply water over the whole area, cut up into about forty homestead blocks. The river flats, about 1,000 acres, would be available for grazing, and could be used under commonage conditions, or otherwise, as might be arranged. The charges for irrigation water supplied should not exceed 15s. per acre per annum on the area irrigated.

The proximity of Mildura should insure a fair number of settlers conversant with irrigation methods. Settlers should possess some capital, either in stock, implements, or cash.



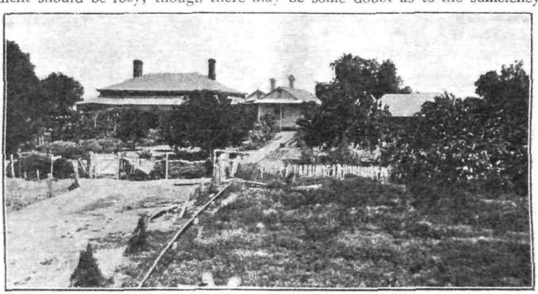
DROUGHT RESERVES, SOUTH AUSTRALIA.

There is much of the inferior Mallee land suitable for wheat growing, but on which the absence of water catchments renders it impossible to secure water storage, and on which it would therefore be futile to attempt residential settlement. By the utilization of the frontage lands (with irrigation), in conjunction with the back lands (without irrigation), this difficulty may to a great extent be overcome, and large areas now practically unused can be rendered productive, thus developing railway traffic or river traffic, according to position. Previously, the Murray waters question has prevented the prosecution of such a scheme, but the present favorable prospects of Inter-State agreement justify the submission of these proposals, which we recommend for consideration."

THE MILDURA CONCESSION.

Within the boundaries of the Mildura Concession, an area of about 200,000 acres, at present held under lease by the debenture-holders, the successors to Chaffey Bros. Ld.—*but the term of which expires in 1911*—there are large tracts of the finest quality of soil and timber. Sandalwood and belar (*casuarina lepidophloia*) predominate; there are also very

large areas of open grassy plains. This class of country runs right down to the river; there are but little river flats, and hardly any inferior country. Old salt-lake beds, or "copi" * flats, occur fairly frequently. Adjoining and above the present irrigation settlement at Mildura is Red Cliffs, an illustration of which appeared in the previous article. Here an area of about 25,000 acres has been alienated to the debenture-holders in exchange for other freehold lands owned by them. It is understood that, at an early date, the whole of this area will be brought under intense culture, on lines similar to Mildura; but avoiding, by using the experience acquired there, some of its initial errors. Pumping would be done by one plant, with a single lift, to the highest point of the settlement, and thence would be distributed throughout by gravitation channels. Only the classes of soil suitable would be irrigated. The chances of success of such a settlement should be rosy, though there may be some doubt as to the sufficiency



KULNYNE HOMESTEAD.

of the local market to absorb profitably the production from an area about twice as large as Mildura itself. Other markets, and oversea ones, must be obtained, and lower prices than our markets accepted.

COWANA.

Adjoining Mildura, but below it, and outside the limits of the concession, there are further areas of first-class land; high, it is true, but easily irrigated, the river being in close proximity to the greater part. Large billabongs, capable of being considerably improved and made into valuable storages, are numerous. The Water Supply Department, some few years ago, marked out an irrigation settlement area here, but no further action has been taken. The first-class lands extend back some 20 miles, until the desert or white-sand and porcupine country is reached, so that there are here practically no inferior interior areas.

The Frontage below Mildura.

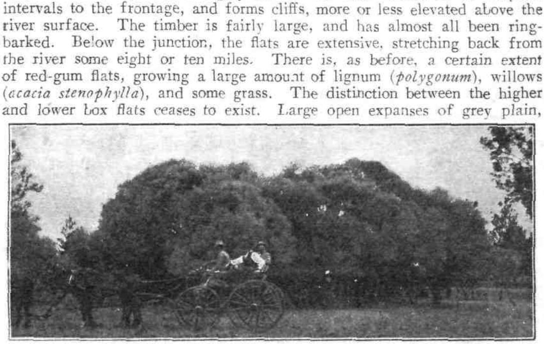
Just below and immediately opposite the junction of the Darling River with the Murray, is Yelta, the site of another irrigation reservation. The important town of Wentworth lies some few miles up from the junction.

* Sulphate of lime, called "copi" by the natives, who used the material largely for decorative purposes as a paint, after being burnt.

Here the frontage changes completely in character, due doubtless to the different class of silt brought down by the Darling River.

THE RIVER FLATS.

From Swan Hill downwards to the junction, the box flats are comparatively narrow, and of small extent. The Mallee country—the red soil, as contrasted with the grey soil of the flats—comes in at frequent intervals to the frontage, and forms cliffs, more or less elevated above the river surface. The timber is fairly large, and has almost all been ring-barked. Below the junction, the flats are extensive, stretching back from the river some eight or ten miles. There is, as before, a certain extent of red-gum flats, growing a large amount of lignum (*polygonum*), willows (*acacia stenophylla*), and some grass. The distinction between the higher and lower box flats ceases to exist. Large open expanses of grey plain,



IN THE BACK COUNTRY, CABBAGE BUSHES.

almost wholly devoid of grass, stretch in all directions. Sparsely scattered about are plants of annual saltbush, and some creeping varieties. Dotted here and there are clumps of box, which require close inspection to make sure that they are box, and not some variety of myall. None of it has been ring-barked. Rarely more than 12 feet high, with its stems twisted and ragged, it is the most mean looking of all the eucalypts. Stumps of trees cut down in the early days of occupation to make fences which have since disappeared, show that the box trees have not grown perceptibly in the last 40 years. The soil is grey, and of a very close texture. It would not be suitable for continued irrigation without considerable expenditure on subsoiling and working. Nevertheless, an occasional flooding, a rare experience, produces a considerable amount of feed. Prior to the advent of the white man and his fleecy flocks, the flats were well covered with saltbush—old man, and the smaller varieties. These are almost extinct in Kulnyne, which occupies about half the distance to the boundary; although they are fairly thick on the lower half, Ned's Corner Run. It is not impossible that with a denser population and smaller holdings, the irrigation of these flats in a cheap way to start the growth of the perennial saltbushes, with some extent of cultivation of the annual varieties for the making of silage, will be found profitable. The experiment will be well worth trying later on. Low rises, a few feet elevation only, occur at infrequent intervals. They are of reddish soil, and run back generally to the Mallee lands; they are probably the caps of buried ridges and spurs from the high ground. One or two in Ned's Corner Run, particularly,

stretch right to the river, and would form suitable points for settlements. There is only one lake, Walla Walla, in the whole length, but this is well suited for storage.

THE MALLEE COUNTRY.

From these river flats rise the Mallee lands, all of the finest quality. They are equal to the best above Mildura, and are much more extensive. In fact, the disposition of the land is reversed below the Darling; above, the frontage is good, and the interior lands of only moderate quality, while below, the frontage is inferior and the back country first-class quality. The good land extends back some 10 to 12 miles, reaching a total distance from the river of about 20 miles, and abuts on the very poor white sand ridges north of the Cow Plains district. Considerable areas of saltbush are interspersed through its extent. Good water catchments are numerous, while the rainfall, though light, is apparently somewhat better than that of Mildura.

RAINFALL.

The records of Ned's Corner Station cover a period of nineteen years, and the average precipitation is 10.20 inches. The records at Wentworth, however, for the much longer period of 35 years, and taken by an official observer, should be more reliable. They show an average rainfall of 11.75 inches. Lindsay Cliffs, in New South Wales, and Renmark, in South Australia, show rainfalls averaging over 11 inches. The mean annual rainfall may, therefore, be set down at a little over 11 inches.

Existing Settlement.

The country from Mildura to the South Australian boundary is held under grazing lease in two properties—Kulnyne and Ned's Corner. The so-called islands, that is, lands lying between the main channel of the river and its billabongs, of Walpoola and Lindsay, belong to the Council of Agricultural Education and are leased to the adjoining run-holders. Three homesteads, Cowra, an out-station, Kulnyne and Ned's Corner, with a few huts for boundary-riders, comprise the whole of the settlement. Wild dogs are numerous and destructive, and rabbits are running everywhere. The back country is fairly well supplied with tanks; but the insecurity of the present tenure precludes much work on improvements.

SETTLEMENT IN THE NEIGHBOURING STATES.

A marked contrast is observable once this State is left. Driving through the Beardy Gate, in the vermin-proof wire-netting fence on the boundary, some 23 miles south of the Murray, into South Australia, evidences of agricultural occupation are quickly met with. A dairy herd of fair quality is first seen, then fences—for the Mallee, fairly substantial ones— appear. Several crops are passed, looking, despite a rainfall well below the average, very promising; parts of them bid fair to yield up to three bags per acre. Stacks of hay just carted in show provision against drought. Continuing, the Murray frontage is reached, all well settled with comfortable homesteads and large cultivation paddocks. Renmark, an irrigation settlement on similar lines to Mildura, is fairly prosperous, although it suffered severely from the heat wave at the commencement of last year. About 4,000 acres are irrigated annually, returning in fruit about £40,000. This yield may be expected soon to considerably increase, as there is a large proportion of newly-planted land, not yet, of course, in full bearing. Several

other irrigation settlements are being established by private persons or syndicates. In some instances, the irrigation of the flats, or, rather, the beds of large lagoons for lucerne growing and pig breeding, is being initiated; others are proceeding on the more accustomed lines of fruit growing.

VILLAGE SETTLEMENTS ON THE SOUTH AUSTRALIAN MURRAY.

To cope with the unemployed problem, and also to experiment with co-operation, there were formed, in 1894, some eleven settlements on the River Murray, on more or less communistic bases. The Government assisted the settlers by loans, and by the construction of pumping plants. Lack of practical experience and inability to maintain the communistic ideals without disagreement, led to the practically total failure of these ventures. Lyrup, near Renmark, but on the opposite side of the river,

A SOUTH AUSTRALIAN SETTLER'S CROP, NOVEMBER, 1905.

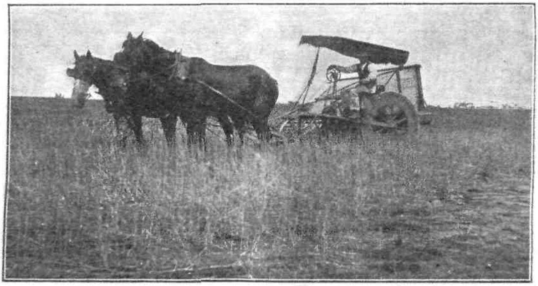
is an exception, and is moderately successful, its proximity to that settlement giving the settlers a chance of learning how to irrigate and cultivate successfully. The abandoned settlements, with the pumping plants, have all been leased for irrigation purposes. The soil, the climate, or the water supply cannot be blamed for these failures. The cause must be sought in the other element necessary to success, and that is man himself. Human nature does not appear to be yet ready for the communistic ideals; certainly not where initial conditions are adverse.

NEW SOUTH WALES.

New South Wales has not done so much with her frontage as South Australia. Only one irrigation settlement, the Wentworth, has been started. It is, as yet, anything but successful, although recent reports show improved prospects. The soil is principally river flats, requiring heavy and frequent waterings, and much cultivation. It is also in parts very saline. Along the frontage, however, are numerous settlers, generally holding under lease, at very low rentals, large areas, including the back country.

Some very fine instances of successful farming are to be met with. Just opposite the most northerly part of Victoria, is Lindsay Cliffs, a farm owned by Mr. Wilkinson. The mail route from Morgan to Wentworth passes close by, and a post-office and police station, known as Cal Lal, adjoin. The area of the farm is 2,030 acres in all, some 600 acres being freehold, and the remainder leasehold. Mr. Wilkinson went there 23 years ago with some hundreds of pounds in cash and stock; his property is now worth nearly as many thousands.

The farm, as an example of successful pioneering under adverse conditions, merits some description. About 30 acres of the frontage is irrigated for fodder, the produce being almost wholly consumed by the working and dairy stock of the farm, comprising some 25 horses and 20 cattle. There are, besides, about 250 sheep grazed on the stubble and fallow. The main reliance is placed on the wheat crop, for which about 600 acres are cropped, a similar area is fallowed, and land cropped the previous year is allowed to stand one year for grass. About 100 acres are cut for hay, there being a lucrative trade on the river for chaff. The average yield



STRIPPING, LINDSAY CLIFFS' FARM.

for the 22 crops harvested is a little over 10 bushels per acre. A new variety of wheat has been cultivated for some years past. The results so far obtained show that an average yield of about 12 bushels per acre would have been obtained had that particular variety been grown for the whole period. Last season, up to 18 bushels per acre were stripped, and the average came to over fourteen. The rainfall for that year was only 8 inches 68 points from January to November inclusive. A very nice orchard, a healthy vegetable garden, and many flowers and shrubs surround a stone-built house, roomy and comfortable. A large wharf, with sheds containing a portable engine driving the centrifugal pump, a flour mill, saw-bench, lathe, and chaffcutter, is close to the house. Large implement sheds and barns hold the latest farm machinery and an ample supply of fodder. A smithy and carpenter's shop contain a more complete set of tools and appliances than are generally to be found in our country towns. The farm gates are of iron, flat and round iron and tubing being used. All this has

been achieved with a rainfall of 11 inches on land generally reckoned useless for settlement except in very large areas.

This account of what has been done in the other States in utilizing the Murray frontage would at first give the impression that we are much behind those States, and have lost considerably by our delay. This is not so in reality. The frontages were held under leases granted in 1883, and expiring only at the end of 1903, just after a protracted period of exceptional droughts. Since then, the scheme of settlement, outlined in the Departmental memorandum quoted above, has been under consideration. The country has been examined, and surveys have been made of selected localities under the supervision of the Surveyor-General, to whom the credit for suggesting the present scheme of settlement must be given. The problem of utilizing our frontage lands so that the interior and really dependent country may at the same time be brought into profitable occupation is no light one. The experiment now to be entered upon with the approval of the Government will need to be carried out with great care, for on its successful issue depends apparently the provision of homes and livings for

WINNOWING, LINDSAY CLIFFS' FARM.

at least 3,000 families. The establishment of such a number of settlers with the inevitable business men and artisans along the Murray River will lend a different aspect to the navigation problem. Locks will be almost essential, both for water carriage and for reducing the lifts of the pumped water.

The Mallee fringe already occupied comprises some three to four millions of acres, of which about one million acres are under cultivation, with returns of over one million pounds sterling per annum in wheat alone. These settlers have survived the most disastrous series of droughts experienced since the settlement of the colony, and are now prosperous. It is not so long since it was asserted, and with much support, that it would pay the State to buy out all the Mallee settlers and allow the country to revert to its original state. The Murray frontage settlers, with an assured water supply, an assured irrigated supply of fodder, and, on the whole, better land, should enter upon their work with even greater prospects of success.

THE COMBATING OF TUBERCULOSIS IN CATTLE AND THE HYGIENIC PRODUCTION OF MILK.

(The Proceedings of the thirty-fourth Plenary Meeting of the German Council of Agriculture, 8th February, 1906.)

His Excellency the Right Hon. Professor Behring, of Marburg, said:— Gentlemen,—The combating of tuberculosis in cattle, and the hygienic production of milk are two questions in which not only cattle breeders and dairymen, but all classes of the population, are deeply interested. Consequently, we find these subjects placed on the order of the day at medical and veterinary congresses, at agricultural meetings of societies for the public welfare, and even in the counsels of the State. In a short report like this, I cannot, of course, touch on every point connected with the two problems; but must confine myself to describing as succinctly as possible what I have myself ascertained to be new and useful in the course of my own investigations.

The question of tuberculosis in cattle has, as we all know, two different aspects—the economical aspect, which chiefly interests agriculturists and the States; and the sanitary aspect, which interests every individual unit of the population. From the economical point of view, and according to the latest computation, tuberculosis in cattle causes a pecuniary loss of 30,000,000 francs (£1,200,000) in France. I have had the opportunity of studying the calculation made by Professor Lorenz, in the Grand Duchy of Hesse. He reckons that among the 300,000 head of cattle in the Grand Duchy, there is an annual loss of meat from this cause to the value of 500,000 marks (£24,500). These are figures the great importance of which must be clear to everybody, and it cannot be called an exaggeration when it is said that cattle tuberculosis lies on agriculturists like a heavy burden, or like a grinding tax, beneficial to no one, of at least 1 per cent., on the whole turnover from milk and beef. According to the figures which I have had an opportunity of seeing, this annual turnover amounts in the German Empire to more than 2½ milliards of marks (£122,500,000), so that, if we assume the damage from cattle tuberculosis to be 1 per cent., we get a total loss from this cause of 25,000,000 marks (£1,225,000) per annum, which is about equal to the loss in France. But this loss, which can be reckoned in money, is not the only one caused by tuberculosis in cattle; it involves one still heavier in the twofold sacrifices of human life. Firstly, by the transmission of the germs of consumption to infants nourished by infected milk, and, secondly, by directly increasing infant mortality, for the milk from tuberculosis cows in its raw state is not a proper substitute for mother's milk, carrying with it, as it does, this danger of transmission of disease, whilst the treatment by which it is sterilized, and rendered innocuous at the same time, deprives the milk of its nourishing qualities.

Therefore, it was a thankful task to search for some means whereby tuberculosis in cattle could be done away with, and it is not to be wondered at that when veterinary authorities and Government boards came forward with the statement that my bovovaccination is an efficacious remedy, a very widespread interest was shown, and all such statements were followed with the greatest attention. Another factor probably played an important part in exciting interest, namely, the hope that as a method has been

found preventing the transmission of the germs of tubercle from cattle to mankind by means of inoculation, so might a means be discovered of protecting human beings by direct inoculation from the transmission of the germs of consumption from other human beings.

And, indeed, it is only natural to suppose that what is possible in lower animals should also be possible in the human race, when we consider that the most important healing processes have been arrived at through experiments on animals. At the close of my lecture, I will say as much as my investigations up to the present time will admit as to the possibility of combating tuberculosis in human beings by new methods. But at present I must confine myself to the subject imposed upon me by the Council of German Agriculture, namely, cow's milk as an article of food, firstly for infants, and secondly for the human race in general.

In cities, especially in large cities, more than one-half of all the infants born have to be fed with substitutes for mother's milk, as the mothers either cannot, or will not, suckle their infants. And it does not seem as if the outcry in favour of natural feeding will have much effect in the near future. On the contrary, it seems as if it were a law of nature that when woman gives up domesticity in order to take part in public life, she loses not only the inclination but also the capability of suckling her own child. (Hear, hear.)

With us in Berlin, two-thirds of the infants born have to do without mother's milk, and let it be noted that it is not among the poorer classes that the greatest percentage of artificially nourished exists. No, the highest percentage of artificially nourished infants is found among families paying the highest rents.

The most frequent substitute for mother's milk—cow's milk—would also be the best if it could be supplied to the child from a healthy cow, in a perfectly clean manner, and in the same fresh state as the naturally nourished child obtains its mother's milk. But this, as we know, is not the case; there is often a delay of from 18 to 36 hours before the infant can get its milk, in which interval the milk undergoes many changes, and is not at all the same article of food as it was in its first state.

And now a word about these changes. They are well-known, and perhaps seemingly trivial, but it is well to realize the chief cause of them. Judging from my own experience, I should say there were two sorts of change, one a natural change, resulting in the sour fermentation of milk, and the other an unnatural change, which we may call an alkaligenous fermentation, whereby the milk remains fluid. In the sour fermentation, the fatty substances rise to the top, while the caseine becomes curdled, and is suspended in the whey or milk serum. This is a process similar to the coagulation of blood; except that we know that the curdling of milk is accompanied by the presence of micro-organisms of bacteria, which produce acids, and this more especially when the oxygen of the air has free access to the milk.

The other, which we call the alkaligenous fermentation, is quite different. This takes place when the oxygen of the air is excluded or driven out; for instance, by heating the milk. The best way to drive out oxygen from a fluid is to heat it. The result is that milk kept in closed bottles is apt to undergo, not the sour, but the alkaligenous fermentation—in other words, to become putrid. We speak of the fermentation of an organic fluid when non-nitrogenous substances are decomposed in it: when, on the

other hand, albuminous (nitrogenous) substances are decomposed in a fluid we get the condition which is called putrid. The milk, which has undergone the alkaligenous fermentation, and which does not curdle, yields compounds of peptonised albumen, which have a smell and a bitter taste and a tendency to the development of gases. Sour fermentation gives us a milk which is still excellent food, though not for infants. The secretion of the caseine and fatty substances prevent it from being in itself a proper food for infants. But sour milk can very well provide food for infants in the forms of butter-milk and whey, both of which have proved an excellent basis for infant feeding, even in cases of mal-nutrition. It is true that carbo-hydrates must be added to the butter-milk because the separation of the fatty substances and of the milk-sugar which passes over into the whey induces a lack of non-nitrogenous substances. Similarly whey must be specially prepared, and this is a very important point; but all eminent children's doctors are unanimously of opinion that the two fluids produced from sour milk, namely, butter-milk and whey, form excellent nutritive material for infants and young children. And however strange this may at first have appeared to scientific men, it is in reality quite natural. The constituent parts of the milk which the infant has need of for his nourishment, and which cannot be replaced by anything else, are not the fat and sugar, which can be given him in many other forms. No; what is absolutely necessary to him, so necessary that he becomes ill if it is withheld from him, are the component parts found in the milk serum—albumen, blood-forming iron, and bone-forming lime. These substances are retained in sour fermentation, but they are totally destroyed in the process of putrefaction. We cannot feed an infant properly with milk which has undergone alkaligenous fermentation; but we can very well feed an infant with the above-mentioned substances taken from milk which has undergone the sour fermentation, for the very sourness prevents further decay—a most admirable provision of nature. I should like to call attention to the fact that comparatively little has been done, even by scientists, in the way of investigating the mineral components of milk by means of experiments on animals. When experimenting on food stuffs, it becomes very clear what an important part is played by the inorganic component parts of milk. There is much talk of milk ferments, and it seems to be believed that these are special substances in the milk, but the investigations which I have been carrying out for several years in my laboratory have shown that the milk ferments are, as a matter of fact, closely connected with those substances in the milk, containing iron, lime and magnesia, which we must realise as being combinations of iron, lime and magnesia, with certain very coagulable albuminous substances. There is still another substance, which is destroyed by the alkaligenous fermentation or putrefaction, and that is the nerve-forming substance, a fatty matter, but one which differs from the fatty matter of butter. Lecithine is also an important element. All these substances are well conserved in sour milk, but they are destroyed in milk which has undergone alkaligenous fermentation.

And now comes a point which must possess extreme interest for cattle breeders and dairymen, namely, that we can repeat the process of alkaligenous fermentation, with all its characteristic features, by the simple heating of fresh milk. By extreme heating of fresh milk, the genuine coagulable albuminous substances are denaturalized. Albuminate is first produced, and then, by further heating, pepton. The milk assumes a

more or less pronounced boiled taste, which gives place later on to the bitter taste of pepton. In boiled milk, all the fermentative qualities disappear, and this I believe to be caused by the disintegration of the albuminous substances combined with the mineral constituents of the milk.

It would, however, be erroneous to exaggerate the disparaging criticism on boiling milk. We are indebted to Pasteur for a process calculated to render the milk bacteria harmless, and at the same time to conserve the natural qualities of the milk. He it was who first called attention to the fact that milk fermentation was caused by bacteria, and who, by his epoch-making discovery of *contagium vivum*, gave a startling proof of cause and effect between bacterial propagation, and fermentation, and putrefaction. I allude to the process of Pasteurising, as it is called, a name which is much too loosely applied in the general tendency to call any sort of milk-heating Pasteurising. Pasteur's process consists of heating milk up to 75 degrees, not higher, and for no longer than half an hour, after which the milk *must* be quickly cooled. I have made the experiment not only with cow's milk but with mother's milk, and find that when quite fresh milk is so treated, it retains the fermentative and cell-forming qualities of milk. It is quite a different matter when milk is heated up to 80 degrees, 85 degrees, or more, all these qualities then being lost. Perhaps I may have time to return to this subject, and point out that by my feeding experiments on calves I have been able to show indisputably that it is impossible to rear healthy calves on milk which has been brought to a high temperature or boiled at 100 degrees. This is not an experience confined to cattle on my own property near Marburg; but one which has been made on estates in Bohemia and Hungary. On the Hungarian estates of Prince Louis of Bavaria, and on the Teschen estates, hundreds of calves have been under observation, some of which have been fed on uncooked milk, and others on boiled milk, showing that milk brought to a high temperature is not suitable for the normal rearing of calves. In the eighth number of my contributions to Experimental Therapeutics, I have given detailed reports of a series of these experiments.

Although I have expressed my approval of Pasteur's method, I must nevertheless mention that it is not always free from danger. If milk which is not fresh, but which has always begun to undergo the alkaligenous fermentation, is heated to a temperature of 75 degrees, the same changes take place as is the case if fresh milk is heated up to 100 degrees. It has been recognised by many children's specialists that milk brought into the house in the first stages of decomposition, and then heated, is the chief cause of many children's diseases, as, for instance, the scurvy-like Barlow's disease, and the rachite disease. All this can be produced in calves, too. I have spared neither time nor money to solve this question, not only in theory but in practice. I have fed a great number of calves regularly with heated milk, and have found that the diseases similar to scurvy and the bone malformations of rickets can be produced artificially, and when I took milk such as is generally given to infants in our large towns, that it was the surest way to kill most of the calves by setting up an exhausting diarrhœa; conditions similar to those that we deplore during the periods of high infant mortality in the summer months.

The subject of milk heating is a complicated one, and cannot be dismissed in a few trite words. But one thing I must say, as a result of my experimental studies, that sterilised milk is not ideal milk, nor yet is unsterilised milk necessarily the essence of everything evil. One fact remains

—statistics and experience show that on perfectly good cow's milk, we can rear up men and women in every way fit to fight the battle of life, as those who have been suckled at the breast, but we cannot say the same about sterilised milk, which is now so highly praised as infant's food.

From all this, you see that the milk question presents a real dilemma. We cannot supply milk fresh from the cow's udder into the houses of the consumers in large cities at moderate prices, and yet we must not employ the sterilising method of heating on account of its deteriorating effect upon the milk. It may, therefore, be imagined that it was a pleasant task to me to search for ways and means of obviating the deleterious effects of bacteriological decomposition, while at the same time conserving the milk so long in a proper state as to enable it to be conveyed to the consumers' houses for infant feeding. It is a great pleasure to be able to inform you, gentlemen, that years of observation have shown this not to be so very difficult after all. I do not speak of formalin milk; I do not allude to the other antiseptic remedies which have proved so valuable to agriculturists in combating mortality among calves. I allude now only to the simple and well-known methods of hygienic cleanliness in the cow-house, which methods I have treated on at some length elsewhere (see "Principles of Milk Hygiene," in No. 8 of my contributions to Experimental Therapeutics), and, lastly, to the proper selection of suitable milk cows. What I have already published need not be repeated, but I should like to call your attention to two things which, as far as I can see, have not yet been sufficiently noticed, at least not in Germany. But first I should like to give some examples of what can be done by the aforementioned means. Last summer, in the hottest months, on my small estate, about a quarter of an hour from Marburg, I had milk from selected cows milked straight into wide-necked bottles. The bottles were closed, and transported to the Institute of Hygiene, the thermometer standing at 20 degrees, and for five or six days these samples of milk kept so fresh that they could be used as sweet milk. I have, moreover, been authentically informed (one case I know of was in Saxony, another in Berlin) that bottles of milk were transported to America and back again to Germany after special precautions for cleanliness had been taken, and the milk still found to be in a perfectly good and drinkable condition. The best results, however, in milking that I have hitherto heard of have been attained by Dr. Willem, in Laeken. With the support of the Ministry of Agriculture, he keeps a certain number of cows under such conditions that he can send milk every day to Verviers, Ghent, and Brussels. It is delivered to the consumers in such a state of purity as regards germs (under 100 germs to the cub. cm.), as is only found in a few exceptional model German dairies. But this is not all. Of the milk thus sent (and this is a business enterprise, not an expensive scientific experiment) some samples are always forwarded to the Hygienic Laboratories in Verviers, Ghent, and Brussels, where they are examined in order to see how long they remain in a state of purity as sweet milk. Thirty-five successive investigations have shown that not a single one of these samples of milk curdled sooner than on the eleventh day; most of them not till between the twentieth and thirtieth days, some lasted fresh till the seventy-fifth, and one till the ninety-third day. These results exceed everything that one could venture to hope. When I learned that Willem's statement of his results was received in many quarters with scepticism, I took measures to inform myelf of his method of procedure. I know Willem to be an extremely trustworthy in-

vestigator of milk, and therefore I can guarantee what he says. The attainment of such excellent results was only possible under two conditions, conditions such as we have hardly contemplated as yet; firstly, the establishment of a special milking room for cows giving children's milk; and secondly, the careful selection of cows suitable for the giving of milk poor in germs. There is only a very small percentage of such cows.

As regards the taking of milk cows into a special milking room, this demand has been approved, at least in principle, in many quarters. I have already seen such milking rooms on a farm near Dresden, in Ohorn, and in other places, though these did not come up to the requirements of a model milking room. There would seem to be too little stress laid on the testing of the air in such rooms for germs, and on seeing that the air is pure enough to meet the demands of an aseptic milking room. I should like to relate my experiences in my own stalls during the last few weeks in the experiments of the well-known children's specialist, Dr. Salge, who has been appointed assistant to Privy Councillor Heubner. Dr. Salge has made very careful comparative experiments, testing the air of the cow-house where the animals are fed, for germs. He was especially careful in testing the air of a separate milking room which I had built into the cow-house, with the result that this room, which seemed to be perfectly fitted for its purpose, and which could be disinfected with steam, was found to be quite unsuitable to the requirements of a milking room for obtaining germ-free milk from healthy cows.

On the other hand, when the animals were milked in a spot on the meadow behind the farm-yard, where the air was almost free from germs, we found all the requirements of an aseptic milking room fulfilled in the simplest way.

Looking at this question, therefore, from a practical point of view, it is very simple to avoid speedy fermentation of the milk. In summer the cows must be milked in the meadow, where there is no dust; in winter, the same difficulties do not arise, and thus we take a very simple step forwards for the provision of milk suitable for infant feeding. But that is not all. You can build the finest model cow-houses—you can fulfil every condition I have laid down, sparing no expense, and yet you may be unable to obtain anything approaching the results obtained by Dr. Willem and myself. And for this reason: a very great deal lies with the cow itself. From recent experiments, made by Dr. Willem and myself, it has been found that in the udder of a healthy, cleanly-kept cow there are no living and propagating germs at all. The milk of a normal milch cow, an ideal milch cow, kept under perfectly healthy conditions, should therefore contain no germs whatever. As a matter of fact, however, there are very few such normal cows in our cow-houses. For instance, among my own 30 milch cows, hardly 10 per cent. even approximately approach the condition necessary in a normal cow.

Now comes another remarkable point. When these cows, which yield so many bacteria in their milk, are carefully examined, it is found that it is by no means the whole udder which is infected by bacteria, but perhaps only one quarter, or, at the most, two quarters, of the udder, the other quarters being normal. We have carried out a great number of excessively troublesome experiments in Marburg, and have convinced ourselves that a cow may have a positively healthy appearance and yet yield an

immense quantity of bacteria from her udder. There is no defect perceptible in herself, or her udder, and yet in a sample of her milk sphærobacteria, so-called streptococci and staphylococci, are found coming from one teat alone in such enormous quantities that this single cow is capable of spoiling the milk of the whole dairy. The fewer of these coccus cows there are the easier it is to keep down the germ contents of the mixed milk of the whole dairy, and from all this it may be understood that, in spite of the finest model dairies, one may be unable to obtain satisfactory results unless one weeds out the so-called coccus cows. We have succeeded in finding a way of sterilizing the udders of these cows, so it is clear that the question need only be approached in the right way to find a satisfactory solution, and to abolish great evils.

And so, gentlemen, without my going into further details, you will see that we are not far from attaining such conditions as will make it possible to obtain milk for infant feeding which will keep fresh from four to six days. When the milk is supplied to consumers in a fairly germ-free condition, there is no objection to its being heated up to 75 degrees C., for not longer than half an hour, or to 80 degrees C. for not longer than a few minutes. If the milk has already been Pasteurised, or otherwise heated before delivery to consumers, or when it has begun to ferment, this is not the case; an alkaligenously fermented milk-remaining fluid would, more especially if boiled in the house, produce an extract of bacteria, yielding no albuminous substances suitable for infant feeding, no blood-forming, no bone-forming, no nerve-forming substances; an excellent medium for bacteria, for vegetable organisms, but unsuitable for the maintenance of animal life. If I may be allowed to use a strong expression, I would say such milk is putrid, and may be classed among manures; it is fit for the dung-heap or the ploughed field, but should have no place in the stomach of a human being, and, least of all, in the stomach of an infant. (Hear, hear.)

If you were to question specialists, you would find that their private views are not so very different from my own. Publicly there are, of course, conflicting interests, which have to be regarded; there are charitable organisations, which would receive no subscriptions if the excellence of their method of sterilizing milk were to be doubted, there are the theorists who are so strongly committed to one method, that they would find difficulty in publicly advocating more recently discovered truths. But go to them in private, and they are quite of the same opinion as myself, and say: "We quite agree with you, we only require milk that we can give to infants just as it is, and without fear of infection." If you were to go to Professor Heubner at the charité, he would say, "I would rather pay 7d. per litre for milk that I can give to infants in its natural state, than half the price for sterilized milk." And this is self-evident. You have only to imagine the adoption of sterilization of mother's milk as it comes from the breast, in such a case you would, in all probability, have worse results than we now have with cow's milk.

But, this being the case, how comes it that the sterilizing of milk could become so widely advocated, and that even medical authorities encourage it? There are many reasons for this. In the first place, I believe it is in a great measure due to the widespread erroneous idea that the human organism is best protected against disease when it is kept in atmosphere, and fed with food, both totally free from bacteria. This is a dangerous error. Experiments made in the Pasteur Institute in

Paris, and by Schottelius in Freiburg, have shown that a newly born animal, human or otherwise, cannot by any means be brought up on sterile food. It would suffer from the lack of agencies which must assist in the function of digestion if this is to be performed properly. So we cannot approach these questions in such an erroneous spirit. When I emphasize this, it implies no contradiction of the fact that there are injurious bacteria. You, yourselves, gentlemen, know better than other people, from the investigations you have made of the root bacteria in your legumes, that, while there are bacteria injurious to your vegetable crops, that does not contradict the other fact that there are useful and harmless micro-organisms. We do not by any means conceal the fact that there are micro-organisms in milk which cause disease, those, for instance, which cause anthrax, and foot and mouth disease. Cows whose udders contain the cocci I have spoken about, though they may appear quite healthy, must be weeded out from the list of those that can supply us with milk for infants in an uncooked state. There are, however, other germs of disease quite unconnected with cows, which may be transmitted by the milkers. During epidemics of cholera or typhoid fever, dysentery, and other human diseases, milkers, who may be ill without being confined to bed, can easily transmit the germs of these diseases to the milk. It only has to be considered how far from cleanly in their person some of these milkers are, as they often have gatherings and sores on their hands, skin diseases, coughs, &c. These evils are patent to the most superficial observer; but from this I do not argue that it is necessary to sterilize milk; but only that as regards milking itself, as well as the way the milk is kept and treated, we should be guided by the same considerations which determine our actions in the question of drinking water. It would not occur to any one to lay down the axiom that drinking water must be *sterilized; though drinking water, as an article of human food, is not* nearly so coagulable as milk. The demand that milk should be kept as scrupulously clean as drinking water, I hold to be not only justifiable, but I feel convinced that this demand will, in a very short time, be officially formulated.

I think that this principle might have been accepted long ago, but that the means were lacking to enforce it, and as is so frequently the case in human life and practice, difficulties which we cannot solve, we pretend not to see. As the matter now lies, I hope I have shown you that it is not a matter of extreme difficulty to obtain and keep milk under such conditions of cleanliness that it can be conveyed to the houses of consumers in a perfectly fresh state for infant feeding. And where the possibility exists, the will will always find the way.

I must, however, mention a further condition, which must be fulfilled before we can give cow's milk in its natural state to infants. This is a condition which has seemed, up to the present time, impossible to fulfil, viz., that the milk should be entirely free from tubercle bacilli. And this condition presents a difficulty, it would almost seem an insurmountable difficulty, in giving milk in its raw state, seeing how diseased our cattle are with tubercle. It is no use lapsing into generalities on this question, time does not admit of it. I will, therefore, come straight to the point, and say that I believe I have found a means of overcoming this last difficulty. I am firmly convinced that in bovovaccination, we have a means of obtaining cattle free from tuberculosis, and in a manner easy of practice; at any rate, much easier than the experiments made with the Bang method.

You are doubtless aware that I am not alone in sharing this conviction. *The scientific basis of bovovaccination has been sufficiently confirmed by* veterinary authorities in various districts and countries. I need only mention the veterinary colleges at Giessen, Darmstadt, Freiburg, Leipzig, Budapest, Alfort (Paris), and Lyons, where there are men whose names are well-known in veterinary science, who have scientifically tested my method of inoculation for the combating of tuberculosis in cattle. The most valuable experiment has been made by Vallée, successor to Nocard, as director of the greatest French veterinary college at Alfort, near Paris. Out of the 40 cows which he inoculated with my bovovaccine, closely following my directions, there was not one single failure. Clinical observation as well as subsequent dissection, showed conclusively that at the end of a year, during which period the same number of cattle kept for comparative observation, had all become tuberculous, every one of the 40 cows inoculated with bovovaccine remained in a perfectly healthy condition. These results made such an impression that at a great meeting held at Melun, at which Vallée read a paper on the subject, a telegram was sent to me saying that those assembled had special pleasure in informing me that I had achieved a triumph with my bovovaccine similar to that which Pasteur had achieved there 23 years before with his anthraxvaccine.

As you are aware, Pasteur was not a doctor. During his whole life he had no right to write a prescription, and yet he revolutionized our medical science. When he wished to introduce his anti-anthrax vaccination, he had the greatest difficulties to contend with. This was drastically pointed out by one of his coadjutors, who said: Every one awaited, with thrilling and, perhaps, malicious expectation, the moment when the total *failure of Pasteur would be clearly demonstrated by the dissections made.*" It was, therefore, not without significance that this telegram made allusion to Pasteur. Not only Vallée, but also Roux, the director of the Pasteur Institute in Paris, had stated that bovovaccine fulfils every requirement of a preventive remedy, that it is absolutely efficacious, and at the same time innocuous. This scientific confirmation of the fact that we have here a remedy against tubercle in cattle does not stand alone. It is also confirmed by the fact that far more than 100,000 units of my bovovaccine have been used in actual practice; these figures speak for themselves.

I should not like to miss this opportunity of alluding to the names of some gentlemen who have taken a prominent part in introducing bovovaccine into practical agriculture. First among these, I may mention Prince Louis of Bavaria, who, for the last three years, has had every one of the newly-born calves on his Hungarian estates vaccinated with bovovaccine by Dr. Strelinger. At a very early stage the question was practically taken up by Count Schwerin at Göhren, and Count Wolfshagen, in Mecklenburg; also by the bailiffs of Archduke Frederick of Austria, and by Prince Fürstenberg. I could also quote names in Belgium, Holland, and Russia; experiments on a large scale have also been carried on in Prussia and other parts of Germany. These are private enterprises; as to State enterprise, the best organization for practical bovovaccination exists in the Grand Duchy of Hesse, where Dr. Lorenz, under the direct patronage of the Government, conducts operations under model conditions, just as vaccination against small-pox is carried on by us.

This will show how natural is the conclusion that the time for testing the effects of bovovaccine is over. It is already an established fact; just as, eleven years ago, the scientific testing of my anti-diphtheria serum came

to an end, and its practical value was established. From a practical point of view, there will be nothing new learned about bovovaccine, though scientific institutions are working away with it, just as they have been working away for the last eleven years with the anti-diphtheria serum, and have made no great progress. I have to mention this, for I find that just those directors of institutions and theoretical professors, who seemingly have no call to create anything useful in therapeutics themselves, are the very people who postpone the recognition of other people's successful efforts till the Greek Kalends, or, at least, until they themselves come forward with some so-called improvement on them.

I have, however, something to say calculated to damp enthusiasts on the subject of the prevention of tuberculosis by inoculation. My expectations of the rapidity of the extinction of cattle tuberculosis by bovovaccination are much more modest than those of the Belgian official veterinary surgeons, who, after tests made with favorable results by a commission, published their opinion in the daily papers to the effect that in a very few years cattle tuberculosis would be quite stamped out by means of bovovaccination. According to my own experiences, I am not so optimistic, and I certainly never have given reason to indulge in such illusory hopes. I now give expression to my opinion that it would be a fatal error to believe that every young calf inoculated with bovovaccine will develop into a perfectly sound cow, and give milk perfectly free from germs. This will not be the case where the inoculation is made in a herd already infected with tuberculosis, and where the calves are not free from it at the time. It is impossible to prove with certainty whether an animal is already infected or not, and I have learned by experience that animals belonging to a diseased herd, and not inoculated with bovovaccine till they are a few years old, occasionally show a redevelopment of the disease at the time of calving; this is then erroneously looked upon as a failure of bovovaccine. I would consequently call your attention to the fact that whereas I would never seek to prevent the inoculation of an animal already infected with tuberculosis, as it can never do any harm, *but only good, yet my bovovaccination is not a cure, but a preventive* against future infection. That does not by any means preclude a beneficial effect of the inoculation on animals already infected. I could mention thousands of examples of this, but it must not be relied on; and it would be most imprudent of me, were I to make promises here to practical agriculturists like yourselves, which might not be fulfilled. I prefer, therefore, to draw your attention beforehand to such contingencies, which are not to be looked upon as a failure of bovovaccination, but as an error in the selection of suitable animals and their treatment.

These seeming failures which I have touched upon do not detract from the recognised success of bovovaccination in practice, and I believe that it will now stand on its own footing. I could very well leave the matter in the hands of other people, and turn my attention to other matters, if it were not that I am compelled to procure the means of pursuing fresh researches in tubercular-therapeutics with the object of combating human disease and human misery. And this brings me to the new means which I hope to find for combating of consumption in human beings, and to which I alluded at the International Congress for the Combating of Consumption in Paris.

In Paris I stated plainly that any attempt to stamp out consumption by means of bovovaccination, could not be recommended. I, at least,

would undertake no responsibility for the introduction of living tubercle bacilli into the veins of a little child for the purpose of preventing consumption. On the other hand, however, I see no objection to vaccinating children with a substance devoid of propagating tubercle bacilli, which has proved useful in the case of subcutaneous injection in animals. At the close of my lecture, I shall give some details regarding a vaccine of this sort which I have named "Tuberculase"—details which have a direct bearing on cattle-breeding and milk producing.

"Tuberculase" vaccine seems to me to be a very useful supplement to bovovaccination; for this last is only intended for very young calves, so that even under the most favorable circumstances, some years must elapse before cows quite free from tubercle are at our disposal for the supply of pure milk for infants' food.

In order to arrive at our goal more quickly, old cattle and the milch cows, which are still healthy, ought to be vaccinated; but the present method, however, of injecting living virus into the veins is not without danger, as the same dose of bovovaccine, which is quite harmless to new-born calves, often produces acute œdema of the lungs in older animals, and kills them. Bovovaccine, which, as you are aware, contains living tubercle bacilli, is injected under the skin. There is not so much danger of a fatal effect, but success is more uncertain; for a great part of the vaccine remains under the skin, and produces a local tubercular disease which militates against successful immunity. Above all, the subcutaneous injection of bovovaccine into milch cows is a serious matter, because living tubercle bacilli can find their way from the local seat of the disease into the circulation, and so into the milk. Therefore, in answer to the many inquiries of dairymen, who make a speciality of children's milk, as to whether they should not bovovaccinate their milk cows, I am obliged to answer in the negative, or with the greatest possible reserve.

At the time of my lecture in Paris, I was already in possession of the "tuberculase" preparation I then alluded to as obviating the danger of the transmission of living tubercle germs into the milk; it is free from living virus, whilst retaining its power of rendering cattle immune. This preparation also has to be injected into the veins, and its production is so troublesome and expensive, and the period in which it keeps good so short, that in its practical employment will be great difficulties.

The hope I expressed in Paris that the efforts made to improve the method of production, and the practicability of this remedy would be successful, has been fulfilled by the discovery of a new method of preserving the immunizing effect of the tubercle bacilli, and simultaneously suspending their animation. The "tuberculase" obtained by this method is a semi-fluid wax-like preparation, is fairly easily transportable, and not so costly in production as to prevent its adoption in practical agriculture.

"Tuberculase" requires to be administered, not only once or twice, but frequently during a period of from two to four weeks; no technical skill is required for the subcutaneous injection, nor does it necessitate the presence of a veterinary surgeon; consequently the cost of administering "tuberculase" is not greater, but rather less than bovovaccine.

I have not only treated cows free from tuberculosis with "tuberculase." but also cows which, although healthy in appearance, yielded virulent tubercle bacilli in their milk. After a few weeks' treatment. I observed

that the tubercle bacilli disappeared from the milk. These observations open up a hopeful prospect for the employment of "tuberculase" in combating consumption in human beings.

I must make special mention of the fact that I have not experimented on tuberculous cattle, whose condition in any way approached that of a human being suffering from tubercular consumption, and that consequently I have no scientific basis for the assumption that "tuberculase" may be a suitable remedy against consumption in human beings. I did not speak in Paris of a curative remedy for consumption, which had already developed, but of a preventive remedy which, by early administration to young people, should prove a protecting means against consumption, and in any case have such an effect on any consumptive centre that self-healing would be promoted and new infection kept away.

I intend to hold to my programme announced in Paris of not making my new remedy for consumption publicly known till the autumn of this year, so that it is absolutely useless for doctors or laymen to beg me, either by telegram, by letter, or in person, to make an exception in their case, and let them have some of it for consumptive patients. My experiences have made me more than ever resolve not to let the remedy go further than those specialists in the investigation of tuberculosis, who are already acquainted with my work in this direction.

Gentlemen, these remarks which I have tried to make as plain and impartial as possible, hold out no hopes which, in my opinion, may not be fulfilled in a short time. What I have said to you I have in such a manner said that it will still be true a hundred years hence; and I hope that the realization of what I have suggested may not be very long delayed. What I still have to say to you is about something else.

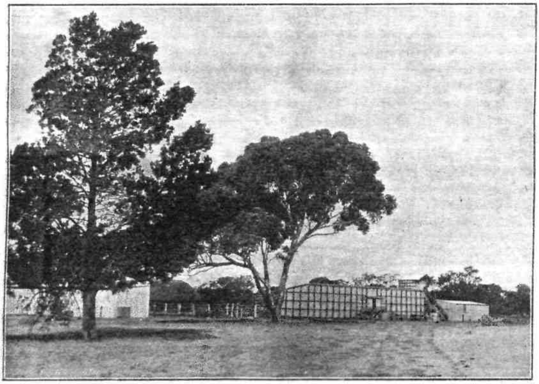
Those of you who remember a lecture I held in Vienna on 12th March, 1902, are aware that one of the chief problems I am working on is the obtaining of milk from cows which have been made immune from tuberculosis in a particular manner; this milk, in its turn, is to transmit the immunity to the infants fed with it. It is a great pleasure to be able to inform you that I am getting nearer and nearer to this goal. It is my duty, however, to add that years must elapse before the process can be made public. To illustrate this necessity, I may tell you that it took four years to bring a certain animal into the condition in which I could obtain positive results from its milk; then another period followed which yielded only negative results. My stand-point is that a result once attained can be regularly attained again by minutely studying and recognising the conditions which governed the first success. This was my starting point in previous investigations, and will continue to be so. It will explain the confidence with which I venture to regard the future—a confidence so great that I do not hesitate to express it in public.

This immunifying milk, then, is a matter for the future; but there is something else which can be realized now. If you agree with me in what I have said about the wholesome feeding of infants, I think we must be consistent, and not shrink from any conflict when so much is at stake. Whoever is thoroughly convinced of the importance of feeding infants with milk which supplies tissue-forming substances in their natural state, or as near it as possible, cannot do otherwise than express this opinion openly, without consideration of person, and try to get it carried out, as I myself do. In this struggle against the heating of infants' milk, I

seemed formerly to stand alone. I am glad that this is no longer the case, and that many other independent investigators, like myself, adopt the motto which I have followed for years in clearing away obsolete ideas:—" Nich ja aber, sondern "na also" (not "Yes, but," but "Well, then").

FARM BUILDINGS—ANCIENT AND MODERN.

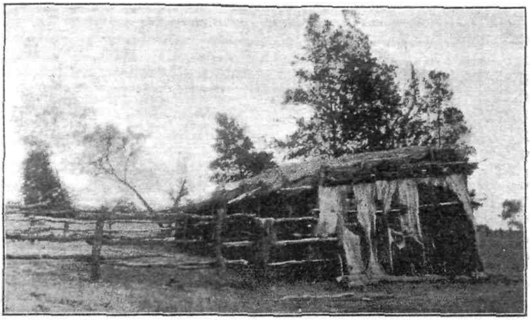
One of the most evident signs of prosperity on a farm is fresh paint on the dwelling and sheds. For this, of course, sheds that are worth



GENERAL VIEW OF PRESENT BUILDINGS.

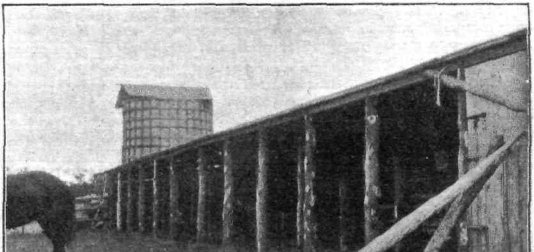
painting are required, so that it may equally be taken as a sign of success where well designed and substantial buildings are to be seen. The one illustration shows a shed or stable, somewhat typical of the Mallee district —at any rate, in the early stages of settlement—a structure which, from all points of view, is just what is should not be. The farm, passing into the hands of a progressive and up-to-date man, has now been equipped with good stables, suitable for the comfort and health of the horses, with roomy and substantial sheds and barns, and with a silo. These may all be seen in the other illustrations. The silo, having previously been filled with chaffed green oaten hay, is now being emptied, and the silage is readily eaten by the sheep on the farm. Further improvements, the enlargement of an excavated earthen tank of some 2,000 cubic yards capacity, the erection of a windmill and elevated tank, and the laying down of pipes to irrigate an acre or two in close proximity to the silo, are in progress. The profit from

good sheds for storing fodder, and particularly for the efficient preservation of implements, is far above the interest on the outlay for the construction.



THE OLD STABLES.

Good stables, properly ventilated, but warm, clean, and kept so, save their cost in a short time, not only in the lengthened life of the working



THE NEW BUILDINGS.

stock, but in the greater amount of work which can be got out of them each day. Similar remarks apply with equal force to milking shed and

yards, and to piggeries. Now, while seasons are good and money plentiful, the farmer should look over his yards and buildings, do away with all makeshift erections, and put up structures of which he may be justly proud, and from which he will reap a substantial benefit.

A.S.K.

CHECKING LOSSES AT BUTTER FACTORIES.

R. Crowe, Superintendent of Exports.

In compliance with instructions from Dr. Cherry, Director of Agriculture, a few experiments were made last season to ascertain the amount of waste encountered in ordinary practice at our butter factories. For this purpose a number of factories were selected in each district, but when the first one had been visited, it was found that there was more urgent work requiring attention. The data secured from the four factories investigated should serve as a standard for future work, especially in the spring and summer months.

In order to secure full details, a programme of the various checks to be made was drawn up for adoption at each factory, so that records capable of comparison would be obtained. The time of the year was favorable to the securing of best results, as the output was well within the capacity of factory plants. This factor should always be remembered when comparing summer returns with flush supplies; and enable directors of factories to readily measure their losses through lack of refrigerating power, or false economy by sparing the refrigerator.

Mr. Archer carried out the tests at factories Nos. 1, 2, and 3, and Mr. Carroll at factory No. 4. Their respective reports are attached, and from those it will be seen that excellent records have been established, especially at two of the factories. The other two also show satisfactory results, and the records indicate the degree of proficiency reached in avoiding losses. It is recognised that all the butter cannot be absolutely secured; those showing the minimum waste may be regarded as a standard of efficiency for the guidance of all managers.

FACTORY NO. 1.

All the supply at this factory is from the private separator source. Most of it is delivered three times a week, practically none daily.

It will be noted that the acidity of the cream was between .47 and .51 per cent.; temperature of cream when churned, .53 to .54 per cent.; percentage of fat in butter-milk, from .1 to .21 per cent. In the three days, 3,313 lbs. of butter were made, and 7 lbs. of fat, or .21 per cent., lost. So far as the experiments have gone, there is a greater loss in the mixed cream factories than the milk supply, and this is a matter that should have further investigation, also where the cream is cooled and kept in separate cans until churned. At the factories where these experiments have been conducted, the cream is cooled and run into vats until churned. The depth to which the churn is filled does not appear to affect the churning

so long as the work is done intelligently, the speed varied a little according to the circumstances, and the cream thinned, if necessary, to insure concussion.

This factory is well managed, as the results show. The manager was very much interested in the experiments, and wished for an opportunity to go further into the matter at a later period. Testing cream is conducted by weight, according to instructions given by me at a former visit, and the over-run is averaged and balanced up every day.

FACTORY NO. 2.

The supply to this factory is partly mixed cream, and partly from milk separated at the factory and creameries. This was all mixed in the vats after cooling, so that it was not possible to get at the amount made from either source separately.

It will be noted that on the first day the acidity was .47, temperature when churned 60 degrees, test of butter-milk, averaged .16, total fat lost 8.4 lbs.. or .43 per cent. of the total; while on the third day, with a lower acidity, viz., 43 per cent., but a lower temperature also (56 degrees), the butter-milk tested .04 and .05, the fat lost was 1.87 lbs., or .138 per cent. of the total.

There must be great loss at this factory at times in the summer, as, owing to insufficient refrigerating power, cream was often churned as high as 68 degrees. A stronger refrigerator is being installed for the next season, however, so that the loss due to high temperature will be reduced. The churns were driven at a high rate of speed, but that was caused through having to drive the shafting quicker to get more power out of the dynamo. A new dynamo is being installed, and the speed will be reduced.

The results of these experiments would tend to show that temperature had the greatest influence on the loss of fat in the butter-milk, and also at the time of churning. If these experiments could be continued in the spring time, very great benefit should accrue therefrom. As it is, much interesting data was obtained. I cannot see that any fault could be found in the management of this factory, except that due to insufficient refrigeration, unless it is that the private separator cream should be made separately, but against that is the fact that a more uniform butter is made by mixing the two.

FACTORY, NO. 3.

This factory treats milk entirely separated at the factory, and its own creameries, consequently a more regular system of management is possible. The advantage of this is apparent in the very low percentage of loss in butter-milk, being on the average only .022 per cent. of the total fat.

So far I have not found a factory where the cream has been churned at a low percentage of acidity. This factory was only churning every second day, so the experiments were not so full as could be desired. The manager was very much interested, and wished to be allowed to assist in the prosecution of further investigations later.

FACTORY NO. 4.

There is no private cream received at this factory, the sources of supply being the company's own creameries. As a result of this system, the

work could be carried out with great regularity. The tabulated record shows that in a well-managed factory, little or no waste takes place. For the total amount of butter manufactured during the period of experiment (17th to 24th March), 3,150 lbs., a waste in churning of only 2 lbs. occurred. This amount represents .063 of the total amount produced, and must be considered a very satisfactory result. It will be noticed that the acidity of the cream never got beyond .42 per cent., and was never less than .40 per cent. at the time of churning. This variation of acidity did not seem to have any appreciable effect on the amount of butter lost in the butter-milk, or did the extent to which the churn was filled affect the cleanliness of the churning.

The whole work of the factory, separating, cooling, and ripening of cream, churning, butter-making, and testing, is carried out with the greatest care and attention, every process of the manufacture being under the personal supervision of the manager. The application of common sense and sound practical knowledge is responsible for the splendid uniformity of the butter produced at this factory, and amongst the employés is found a genuine interest in the company's welfare.

RESULTS OF EXPERIMENTS.

TESTS.	Averages during period of investigation.				
	Factory No 1.	Factory No. 2.	Factory No. 3.	Factory No. 4.	Average of Averages.
Temperature of cream on arrival	66·6	67·3	60	74	66·975
Temperature cooled to ...	53·0	59·3	...	48·8	53·7
Temperature of cream-room	55·0	60·0	58	50·6	55·9
Acidity of cream on arrival	·47 per cent.	·373	...	·388	0·41
Acidity in morning ...	·486 per cent.	·47	·48	·406	0·46
Temperature of cream-room in morning ...	53 deg.	55·6	57	56·6	55·5
Temperature in vat ...	53	58	54	52·8	54·45
Temperature when churned	54·6	58·3	54	57·2	56
Temperature of butter milk ...	56	...	...	55·6	55·8
Amount of cream daily ...	2,285 lbs.	...	...	1,230	1757·5
Amount of butter made ...	1,104	1,866	1,570	630	1292·5
Amount of fat	...	...	1,300	...	...
Percentage of overrun (actual)	17	20	20·77	20	19·4
Test of buttermilk ...	·156	·09	·042	·065	·0875
Percentage of butter fat lost	·22 per cent.	·23	·022	·06	·133
To what extent churn filled	½	½	¾	¾	¾
Speed of churn, revolutions per minute ...	50	54	41	35	45
Speed of churn, feet per minute	600	610	475	420	526
Per cent. contents other than butter fat by flask	...	16·6	17¼	16½	16·78
Moisture by evaporation	...	13½	13½	...	13½
Per cent. of salt by test ...	1·99	1·65	2·15	2·18	1·99
Time cream took to break	23 min.	24 min.	22 min.	31 min.	25 min.

SLUGS.

C. French, F.L.S., F.E.S., Government Entomologist.

Slugs belong to a group of animals known as Mollusca, and may be broadly divided into the shell-bearers and the naked mollusks. The life history of the native species of the latter is but little known, and is now being studied by specialists.

The large speckled garden slug and some other kinds, together with the common garden snail, have been introduced into Victoria through the agency of pot-grown plants sent here in the early days of the colony in Wardian cases, also in the soil in which some of these plants were packed.

The life-history of the slug is a somewhat simple one, the eggs being laid in batches, and as many as five or six hundred eggs may be laid in a season. The eggs are small round bodies, with a skin as soft as parchment. According to some observers, the vitality of these tiny eggs is almost incredible; they may be squeezed nearly flat, and still survive. In Victoria, the eggs of the slug are deposited nearly the whole year round, hence the enormous numbers which occur in seasons favorable to hatching, especially in land of a heavy nature and irregular surface. The eggs are not hatched all at one time; according to Mr. Wotton, who has studied the various British species, several days frequently intervene, the average period being about 60 days (in England), but is probably much less in our warmer and more congenial climate. Extremes of any kind are against the chances of rapid propagation.

When the slugs are hatched, they begin to crawl, and, as we know to our cost, soon commence to eat freely. In England, according to the best authorities, full growth is attained about the middle of the second year, and nearly all die at the end of that year or the beginning of the next. In some species self-fertilization appears, according to Mr. Wotton and others, to be an established fact.

With regard to the Victorian species, of which there are many, especially in forest lands, it may be mentioned that no matter how short a period has elapsed since fires have passed through the country, the small black slugs may be found almost anywhere. On land which has been out of cultivation for years—30 years, to my own knowledge—when a rail is lifted or a piece of cow-dung turned over, slugs are always to be found, but not in such numbers as in gardens. This points to the fact that birds and other agencies have united in keeping the slug pest in partial subjection. In grass lands particularly, vast numbers of slugs are annually destroyed by magpies, crows, mud-larks, and other insect-eating birds.

Slugs are mostly nocturnal in their habits, but will also feed in the day time. It is, however, at night and just before daybreak that both the slugs and snails do the most damage to vegetation. The common snail, excepting after a shower of rain in summer time, usually makes itself scarce when daylight appears.

The slug question is one well worthy of much attention, as it is most discouraging to lovers of horticulture, and to those growing vegetables,

either for private use or for sale, to find their efforts sometimes rendered useless owing to the depredations of both slugs and snails.

Numerous articles for the prevention and destruction of slugs have been published, but the advice here given has been mostly gained by a long personal experience.

PREVENTION AND REMEDIES.

See that the lands are properly drained, and as few hiding places as possible left in which the slugs can secrete themselves. Keep the land as well stirred as possible, as this will be a sure way of destroying vast quantities, both old and young. Do not use stable manure, except for mulching, as there are now suitable artificial manures, which, whilst fertilizing the soil, do not afford shelter for slugs. When digging land, especially heavy soil, give a good dressing of lime, as slugs dislike lime in any form whatever.

The two most reliable remedies are, without doubt, lime and tobacco. When lime is used, it should be as fresh as possible, and renewed afte rain. For young slugs, which are hidden in the ground and are difficult to get at, lime water is an excellent thing to use. It will kill off large numbers of the pests. Watering the infested parts with a weak solution of ammonia, prepared by dissolving solid ammonia in water, has been tried with good results. Lime placed in rings around the plants is alsc a good remedy, but in doing this, care should be taken that some lime be laid close to, but not touching the plant, otherwise if this precaution be not taken, the small slugs will come up within the lime zone and ea the plant before daylight reveals the damage done.

Tobacco is best used in dust form. This substance appears to paralyz the slugs which, together with snails, may frequently be found either deac or helpless in the dust of the tobacco; they cannot stand the substanc in any form, but although they will sometimes cross leaves and eve stalks of refuse tobacco, the dust appears to be a barrier to their progress

Slugs show a decided preference for food of their own kind. If a number of slugs are killed, they are greedily eaten by their comrades, wh will not leave their meal until the last particle is gone. Trapping slug is also a good plan to adopt. The best method is to place cabbage leaves which have been gently fried in a little grease, here and there among th plants. Before retiring for the night, go out with a lamp and shake th leaves into a bucket containing strong salt or lime-water.

Spraying the food with Paris green is also a good method, and s is the laying of beef or mutton bones about the garden, as bones hav a great attraction for slugs. Soot is not relished by them, and will ofte prove of great use both as a deterrent and as a fertilizer. The well known method of hunting for slugs and snails by lamp light is too wel known to need explaining here, and the process is not a very agreeable one

Another cheap and effectual way of dealing with these pests is to plac circles of carbolized saw-dust around the plants, as they will not cross th saw-dust, or go near to where it is; it has the additional merit of bein fairly permanent, frequent renewal being unnecessary.

Zinc bands or circles are also useful, but when rain comes and cover them with dirt, the slugs will then crawl up the outside of the bands a easily as possible.

The keeping of poultry, gulls, and other birds in infested places, is to be commended, as it is astounding what a number of slugs some of these birds can devour. Although young ducks are useful helps in this way, they are too fond of peas and many other vegetables to be trusted in most gardens. There are various articles sold for the purpose of destroying slugs, but these are, in most cases, too costly for growers on a large scale.

A NEW POTATO.

Alfred J. Ewart, D.Sc., Ph.D., F.L.S., Government Botanist.

In the May number of the *Agricultural Journal of the Cape of Good Hope* (Vol. XXVIII., page 618), mention is made of a new potato (*Solanum Commersonii*), whose good qualities have been very extensively advertised in France and abroad by M. Labergerie. The yield of the potato is given as from 5 to 20 tons per acre, without any cultivation after the first year beyond a little hoeing, and the labour involved in digging up the crop. The plants are also stated to do best on wet marshy soils; to grow well between trees; to stand frost; to have a high yield of starch; and to be immune to disease. It has been suggested that it will prove particularly valuable if introduced into Ireland.

Attracted by these statements, the enterprising Engineer of the Birmingham Drainage Farm, which is about 8 square miles in extent, procured samples of this potato at an extremely high price from its exploiter, and submitted them to me for testing. Samples were grown in various situations on agricultural land, and at the Birmingham Botanical Gardens, and the results were uniformly highly unfavorable. The tubers were small, and had a very unpleasant bitter taste, rendering them useless as a table vegetable, although pigs will eat them, especially after they have been boiled. The yield was also small, in some cases being less than the amount first planted, while the tubers were very much less starchy than the ordinary potato. The plant forms long runners, which creep underground to a distance of 1 or 2 yards in a single season in rich wet soil, and these make the plant very difficult to eradicate when once it has established itself. The smallest portion of these runners, if it includes a scale-leaf, or node, will grow when left in the soil.

Altogether, the potato proved to be utterly unsuited for ordinary cultivation, and should its fame reach agriculturists in Victoria, they will be well-advised to fight shy of it. It is worthy of note that this much advertised potato is not a new one, but is an introduction from Brazil, which has long been known at Kew. Further, it does not stand frost as M. Labergerie states, although naturally mere surface frost will not kill tubers below the ground unless it reaches them.

It remains to be seen whether the sweet variety with violet pulp, which M. Labergerie has evolved in response to complaints as to the bitter taste of the original tubers, has any more real value and tangible existence than the remarkable horticultural wonders so often produced, on paper, in America. So far as can be seen at present, the only possible use for

this potato would be to plant on swampy waste ground, over which pigs were allowed to roam, and root out the tubers, but even here it would be a weed yielding little return, and preventing the utilization of land, which when drained would be put to better use. Bearing in mind the fact that several introduced Solanums are becoming troublesome weeds, and that another one (*Solanum heterandum*) has recently appeared in this State, the introduction of yet another in the guise of a cultivated potato, is hardly advisable.

It is possible that by crossing with the ordinary potato interesting and possibly useful varieties may be obtained, but we have no evidence that this has yet been done, and such work involves a considerable expenditure of time and money. As matters are at present, M. Labergerie's tubers do not deserve in any way the extravagant praise bestowed upon them.

ADVANTAGES OF THE SILO.

Even in the irrigation districts where green feed is available throughout the year, the silo is proving indispensable to the dairy farmer. Its value in storing the surplus production of the warm season to tide over the less productive time of winter is very great. Mr. H. Jacob, of Mildura, writes:—

"I have now all the maize in the silo. I also put in some green barley. The silage has turned out better feed than I expected, as the maize was rather dry, and the cattle ate the cobs only, wasting the rest. Now all of it has a sweet smell, and the cows are very fond of it, and are milking well. I have no waste; the cows eat up every scrap. If the maize had been left on the ground, the frost and rain would, by now, have spoilt the lot. So I think that, even under irrigation, with a regular supply of green feed, a silo is a necessity.

"I find the silo and elevator very useful for chaff; there is no bagging or clearing up, the only work being to feed the chaff-cutter. One man, feeding and driving the horses, can cut enough in an hour to last a day."

A.S.K.

BUILDING UP THE HERD.

"Only about six times during the past two years has our weekly herd test fallen below 4.0, whereas it used to get down to 3.4. Even then there was no more milk—actually less; not only so, but the cows we now have for sale are eagerly sought after by previous buyers in our own locality. This is a good testimony to a system of culling by butter production, and selling cows by what they have actually done. We also send out each year a few young bulls from picked cows. Although we have not got up to the yields on many of the rich dairy farms, we are far above the average, and intend to plug along steadily."—Extract from letter from A. L. Galbraith and Sons, Tyers, Traralgon.